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ASPECTS OF FLUID INTAKE RELATED TO DENTAL HEALTH

by

JOANNE CLOVIS

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled ASPECTS OF FLUID INTAKE RELATED TO DENTAL HEALTH submitted by JOANNE CLOVIS in partial fulfilment of the requirements for the degree of Master of Science in the Department of Dental Health Care in the Faculty of Dentistry.

ABSTRACT

The availability of fluoride in fluoridated and non-fluoridated communities has been questioned in recent years. The precept of water fluoridation for the prevention of dental caries is the daily addition of one milligram of fluoride to the diet through the ingestion of one litre of water fluoridated at one part per million. Oral fluoride supplements may be prescribed for children without access to optimally fluoridated drinking water on the basis of the daily addition of one milligram of fluoride to the diet from supplements and drinking water. Recommended dosages for oral fluoride supplements have not included consideration of the changing drinking patterns of children in conjunction with the availability of fluoride in beverages other than drinking water.

A study was undertaken to describe the beverages contributing to the fluid intake of children in winter and in summer; and to compare non-fluoridated and fluoridated communities with respect to beverage intake, the range of fluoride intake from beverages, and the dental health of the children. A beverage record - DRINK DIARY - for Thursday, Friday and Saturday was completed by approximately 60 per cent of the grade six children in the cities of Camrose and Wetaskiwin in winter (-2.7°C and -2.8°C respectively) and in summer (+14.5°C and +14.0°C respectively). Camrose water is non-fluoridated (0.23 ppm fluoride); Wetaskiwin's is fluoridated (1.08 ppm fluoride). Of the 61 females and 58 males in Camrose who completed the winter diary, 58 females and 53 males also completed the summer diary. Of the 45 females and 49 males in Wetaskiwin who completed the winter diary, 39

females and 46 males also completed the summer diary.

Two dentists, with established interrater reliability, examined 204 of the drink diary participants. Of these, 77 in Camrose and 53 in Wetaskiwin were known to have resided in their respective communities for five or more years.

The results of the beverage intake records showed no significant differences between winter and summer or between non-fluoridated (Camrose) and fluoridated (Wetaskiwin) communities with respect to beverage intake. A ranking of beverage categories by mean intake for three days and frequency of consumption showed that the top four categories were milk, water, carbonated beverages, and other beverages prepared by adding tap water in the home. The daily mean intake of all beverages was 1,211 millilitres. There were significant differences between females and males in the means of several beverage categories in both Camrose and Wetaskiwin, winter and summer ($p < 0.01$). The most highly significant differences were those between the means of three-day intakes of milk for all females and males in the summer ($p = 0.0000$) and between the aggregated winter and summer means of three day intakes of all beverages for Camrose females and males ($p = 0.0000$).

The considerable range of fluoride intake from beverage consumption in both cities was a result of choice of beverage as well as total quantity consumed. The range of fluoride intake was 0.02 ppm to 0.82 ppm in the non-fluoridated city (Camrose) and 0.40 ppm to 2.45 ppm in the fluoridated city (Wetaskiwin). Although it is not possible, in the case of Camrose, to show that such a range represents the fluoride intake of children aged four to seven who would be at risk of developing fluorosis, it does demonstrate the availability of fluoride

in a non-fluoridated community, particularly in the form of carbonated beverages which have been prepared with fluoridated water.

When all of the children examined were considered, no signficant differences were demonstrable with respect to the oral health indices of gingivitis, oral hygiene, DMFT, and DMFS of children in non-fluoridated Camrose and fluoridated Wetaskiwin. Even considering only long-term residents of five or more years, there were no significant differences in the caries indices DMFT and DMFS of children in the two communities. The DMFT indices, when compared with 1963 indices, showed nearly identical indices for Wetaskiwin but a dramatic decrease in Camrose from 6.1 teeth to 2.43 teeth.

Whereas oral fluoride supplements do not appear to have contributed to caries prevention, fluoridated dentifrice is likely to have been a major contributor to caries prevention. Fluoride intake from carbonated beverages prepared with fluoridated water may account, in part, for the reduced caries prevalence in Camrose.

Future investigation should attempt to identify a beverage intake profile for children aged four to seven, those whose permanent dentition would benefit most from ingestion of fluoride. Additional investigation should be directed towards identifying a fluorosis index for children in comparable non-fluoridated and fluoridated communities to determine dental exposure to fluoride. Meanwhile, oral fluoride supplements should be prescribed at not more than one-half the current dosages in order to prevent fluorosis in those who may be at risk through beverage consumption and ingestion of other sources of fluoride.

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CHAPTER I

THE PROBLEM

Background to the Problem

The Relationship of Fluoride to Dental Caries and Fluorosis

The relationship between the concentration of fluoride in drinking water and lowered incidence of dental caries is indisputable. An equally indisputable relationship exists between fluoride concentration and dental fluorosis (WHO Mono. 59, 1970; Myers, 1978; Murray & Rugg-Gunn, 1982). The benefit of dental caries reduction was, moreoever, a serendipitous discovery resulting from the investigation of fluorosis. Subsequent inquiry and application of findings led to the advocacy of fluorides, both systemic and topical, as powerful measures for the prevention of dental caries.

A Historical Perspective of Fluoride

The history of the relationships between indicators of dental health and fluoride began with the observations of Dr. F. McKay in Colorado, U.S.A. at the turn of the century. In 1902, McKay observed on the teeth of local inhabitants an apparently permanent stain which he called "mottled enamel" (McKay, 1916a). Excited by the absence of dental caries in the mottled teeth, he proceeded to investigate the etiology of the stain. His observations of endemic areas of mottling led him to hypothesize that some element in the water supply was responsible (McKay, 1916b). Many accounts of related events from that

time to the present appear in the literature. Two excellent reviews have been prepared recently by Jenkins (1982) and Murray and Rugg-Gunn (1982).

H.V. Churchill (1931), a chemist responsible for testing aluminum and bauxite, was able to show that fluorine as fluoride was present in amounts equal to or greater than 2.0 parts per million in community water supplies in areas of endemic mottling . No precise correlation between fluoride content and mottled enamel was established, however, until Dr. H.T. Dean of the U.S. Public Health Service was assigned the task of planning a program for defluoridation to arrest and prevent mottling or fluorosis (Murray & Rugg-Gunn, 1982). Dean (1936) undertook studies to determine the minimal threshold of toxicity of chronic endemic dental fluorosis. Dean, Arnold and Elvove (1942) were able to confirm Dean's earlier studies with considerable epidemiological data and showed that near maximal reduction in caries occurred with a concentration of 1 ppm F in the drinking water.

The next phase was the application of these findings to determine if dental caries could be reduced in a community by adding fluoride at 1 ppm to a fluoride-deficient water supply. Numerous controlled intervention studies formed the bases for the classical studies of fluoridation and were the experimental proof of the cause and effect relationship between fluoride in the drinking water and reduced incidence of dental caries (Murray & Rugg-Gunn, 1982).

A critical link in determining the optimal fluoride concentration in drinking water was the definition of the relationship between climate, fluid intake, and dental fluorosis. In 1942, an American

public health biochemist, F.J. McClure, investigated the total amount of fluoride ingested through drinking water and other sources, given that the drinking of water was a variable factor. He suggested that the quantity of water ingested among children is greatly influenced by atmospheric temperature and humidity. McClure (1943) found that the ingestion of fluoride in drinking water at 0.5 to 1.0 mg of fluorine daily plus the ingestion of fluorine in foods in the average diet resulted in an average daily ingestion of 1.0 to 1.5 mg of fluorine. This intake averaged about 0.05 mg daily per kilogram of weight for children of ages one to 12. His later survey of fluorine in foods (1949) showed that the major source of fluoride in the diet was drinking water.

The definitive studies on the influence of climatological factors on the water intake of infants and youth were completed by Galagan et al. (Galagan, 1953; Galagan & Lamson, 1953; Galagan et al., 1957; Galagan & Vermilion, 1957) who found that temperature was an independent variable which influenced water consumption. A formula for determining optimum fluoride concentrations for community water supplies, which took into account variations in environmental temperature, was suggested by Galagan and Vermilion (1957) and is summarized in Chapter II.

Fluoride Intake from Fluids

The largest single component of daily fluoride intake is fluoride in drinking water (Myers, 1978). Other major sources of fluoride are fluids made with tap water and non-tap water fluids. McClure (1943)

showed that drinking water provided 25 to 33 per cent of total water requirement. Galagan and Lamson (1953) showed that the most important determinant of water consumption was the maximum daily temperature. Walker (1963) found that total fluid intake increased with age to approximately 1,250 ml per day at age 12 and older and, relative to total fluid intake, consumption of tap water appeared to decrease. McPhail and Zacherl (1965) found that at a climatic temperature of 50°F water intake was no longer relative to atmospheric temperatures but was influenced instead by the artificial environmental temperatures of home, school, or work places. Marier and Rose (1966) began to focus concern on the probable increases in the fluoride content of foods and beverages as an indirect result of water fluoridation.

Statement and Importance of the Problem

Dental benefit and dental risk from fluoride are both related to the level of fluoride in the drinking water. The appropriate concentration of fluoride in drinking water to achieve minimum caries with maximum safety has been well documented (Dean, 1936; McClure, 1943; Galagan & Lamson, 1953). Remarkably, the difference between amounts which maintain low levels of dental caries and those at which dental fluorosis begins to appear is the difference between 1 ppm and 2 to 2.5 ppm in drinking water (Hodge, 1950; Galagan & Lamson, 1953).

The fundamental precept of water fluoridation is the addition of one milligram per day to total individual dietary fluoride intake through fluoridated water. This value is based on the assumption that

one litre per day of fluoridated water is consumed in addition to the diet. An indirect result of water fluoridation, however, is an increase in the fluoride content of foods and beverages which have been commercially or domestically prepared with fluoridated water (Marier & Rose, 1966; Ericcson & Wei, 1979). Beverages, in particular, may reflect an increase in total fluoride intake if their preparation has included the addition of fluoridated water (Singer & Ophaug, 1978; Schultz, 1976; Shannon, 1977; Hargreaves, 1984).

A compounding concern is that food and drinking habits are changing; milk and water may be replaced with other beverages or with domestic preparations using fluoridated water (Ericcson & Wei, 1979; Singer & Ophaug, 1978). Pao (1981) reported that the use of soft drinks in the U.S. was considerably greater in 1977 than in 1965, especially among teenage boys 15 to 18 years of age, but also among children one to two years of age. In Canada, soft drink sales increased by 37 per cent from 1972 to 1981 (Hargreaves, 1982).

Beverage consumption and the availability of fluoride through beverages, in fluoridated and non-fluoridated communities, is the problem investigated in this study. An increase in the consumption of beverages prepared with fluoridated water would increase total fluoride intake, and thereby reduce the requirement for supplemental fluoride, whereas an increase in the consumption of beverages prepared with non-fluoridated water would decrease total fluoride intake. The significance of investigating this problem is the potential revision of presently accepted dosage schedules for oral fluoride supplements.

Description of the Study

Purpose

The purpose of this study was to investigate the growing concern about the availability of fluoride in fluoridated and non-fluoridated communities. The concern expressed in the literature is that children may be drinking less water than earlier studies have shown and that they may now be drinking other fluids or beverages as alternatives to water. Moreover, beverages with a fluoride content are available in non-fluoridated communities and these sources of fluoride are not given due consideration in the recommended dosage schedules for oral fluoride supplements which are traditionally and currently prescribed on the basis of the fluoride concentration of the drinking water and the age of the child.

Objectives

The primary objective of this study was to describe the types of beverages contributing to the fluid intake of a population of children in two communities, fluoridated and non-fluoridated, during two seasons, winter and summer. Comparisons could then be made of the children's winter and summer beverage intake; and the fluoridated and non-fluoridated areas with respect to beverage intake, the range of fluoride intake from beverages, and the dental health of the children.

Hypotheses

This study was designed to test four hypotheses: the winter and summer beverage intakes of children are not different; the beverage

intakes of children in fluoridated and non-fluoridated communities are not different; fluoride intake from beverages is greater in fluoridated than that in non-fluoridated communities; and, the dental health of children in fluoridated communities is better than that of children in non-fluoridated communities.

Assumptions and Limitations of the Study

The findings of this study can be generalized to other populations of children of the same average age and living in similar environments. All children of ages 6-7 and 11-12 residing in the cities of Camrose and Wetaskiwin were invited to participate in this study. All schools, both public and separate, were included. The proportion of students considered representative of the population of ages 6-7 and 11-12 was equal to or greater than 50 per cent.

The second assumption was that the content and intent of instructions to the principals, teachers, children, and parents were appropriate. The study was intended to require minimal teacher and parent involvement. Instructions for students were therefore critical to the accuracy of information obtained from them, and were presented in a standardized format and in accordance with acceptable teaching methodology.

A third assumption was that the air temperature would not vary significantly during periods of data collection; it was expected to vary less than $\pm$ 10°C of the 20-year mean winter and summer values. Each of the two data collection periods was expected to require

approximately three weeks to complete.

A limitation of this study was the necessary reliance upon principals and teachers to encourage the return of both the consent forms and the beverage diaries. Personal contact with principals and teachers was established and maintained in order to ensure their motivation in facilitating student access and participation.

It was noted that sources of fluoride other than beverages - fluoride dentifrices, rinses, and gels - may have been available to the children in this investigation. Within the parameters of this study, however, no attempt was made to assess their potential impact on dental health.

CHAPTER II

REVIEW OF SELECTED LITERATURE

Literature Pertinent to the Problem

Optimal Fluoride Concentration in Drinking Water

It was the investigations of endemic dental fluorosis which led eventually to the establishment of the currently accepted optimal fluoride concentration in drinking water. Dean's index of fluorosis (1936) was the first attempt to record quantitatively the severity of mottling. He identified six categories of severity and showed that the mildest form of mottled enamel could develop in about ten percent of persons drinking water containing 1 ppm fluoride. At 1.7 to 1.8 ppm fluoride, the incidence could rise to 40 to 50 percent although most would be of the 'very mild' and 'mild' types. Near maximal reduction in caries experience was shown to occur with a concentration of 1 ppm F in the drinking water (Dean et al., 1942).

A graphic presentation of the point of minimum caries with maximum safety was provided by H.C. Hodge (1950). He used the data of Dean and his collaborators to plot caries experience and fluorosis against ppm fluoride to demonstrate the regular and linear decreases in caries with increasing fluoride content. The point of minimum caries with minimum fluorosis is clearly 1 ppm fluoride.

The numerous investigations of Galagan et al. established

climate, particularly maximum daily temperature, as an important factor in determining optimum fluoride concentration. Several climatic and nonclimatic variables were considered; increased water consumption as a result of higher daily maximum temperatures was shown to be related to increased fluorosis (Galagan & Lamson, 1953). Galagan and Vermilion (1957) suggested a formula for determining optimal fluoride concentrations. In the formula "parts per million of fluoride = 0.34 - E", the constant "0.34" was calculated from data for an area with known optimal fluoride concentration. "E" represents the estimated average daily water intake for children through 10 years of age in ounces per pound of body weight and may be calculated from the estimation equation "E=0.038+0.0062 x temperature", where temperature is the mean maximum temperature in degrees Fahrenheit.

Witkop, Barros and Hamilton (1962) further suggested that milk consumption be considered a variable in determining optimal fluoride intake levels in domestic water. Galagan's formula was calculated on the basis of U.S. children consuming about 44 percent of their fluid intake as milk. Witkop's study of children in northern Chile led him to conclude that where milk is not a major source of fluid intake, the intake of total fluoride is greater, as more fluoridated water is consumed. Witkop consequently recommended a milk correction factor in Galagan's formula in recognition of the reduced requirement for fluoride in community water supplies.

Fluid Intake of Children

McClure (1943) suggested that the drinking of water is a variable

factor influenced by atmospheric temperature and humidity. He estimated the daily water requirement as equal to 1 cc per calorie of energy in the daily diet. He furthermore assumed that drinking water ranges between 25 and 33 per cent of the total water requirement. He then calculated the range of drinking water intake to be between 812 and 1,166 milliliters per day for ages 10 to 12.

Neumann (1957) in a study of 312 children under age six, found that the average intakes of milk and water were 840 cc and 294 cc respectively. The considerable range of drinking water consumed daily clearly demonstrated the variability of tap water intake among the children studied.

Galagan et al. (1957) in a study of climate and fluid intake, found that intake per pound of body weight was highest among infants, decreased with age, and varied directly with temperature. A total of 455 children were divided into study groups of 12, a boy and a girl in each of six age groups from infancy through age ten. Data were collected over a one year period. The mean daily fluid intake for boys and girls age 9-10 was 0.64 ounces per pound of body weight with a mean weight of 80.05 pounds. Positive correlations of temperature with total fluid, with drinking water, with water-based beverages, with total water, and with carbonated beverages intakes were significant at the one per cent level. It was suggested that humidity was unlikely to have an important influence on the fluid intake of children.

Walker (1963) in a study of 797 children in four diverse geographic areas reported no differences in the total fluid intake of children from infancy to age 12 and older. At all ages, tap water

provided less than half of all fluids consumed. For children aged 12 and older, the mean total daily fluid consumption was 1247 ml.

Bonham, Gray and Luttrell (1964) recorded one week of the fluid intake of 160 six year old children living at 54°N latitude. Total fluids ingested ranged from 11.7 to 91.0 ounces per day; the average daily intake at 0.7 ounces per pound was lower than that reported by Galagan and Neumann. The authors suggested that fluids ingested on the basis of individual preference, independent of the major physiological demand imposed by a hot climate, might result in a much wider quantitative range of intake levels in cool climates.

McPhail and Zacherl (1965) patterned a study after the aforementioned study of Galagan and Vermilion. A total of 189 children from infancy to age ten were recruited for five-day recordings of fluid intake. Recordings were carried out on alternate weeks from July, 1961 to May, 1962 in Edmonton, Alberta. Water intake in ounces per day per pound of body weight was found to be consistent with Galagan and Vermilion; that is, highest in the under one year age group and decreasing with succeeding age groups. Total fluid intake ranged from 700 to 1,300 ml daily over the age span one to ten. In contrast to Galagan and Vermilion, the means of tap water consumption in winter and summer showed no significant difference, suggesting that the effect of climatic temperature on water intake at about 50°F may be altered by the influence of the artificial environmental temperature created by indoor heating of homes and schools.

Hargreaves (1977) showed that the daily mean fluid intake of Canadian teenagers was 1,100 ml.

Fluoride Ingestion from Fluid Intake

The sources which contribute to the total fluid intake of children vary in relative quantities with age. Calculations of relative quantities have also varied over the last 30 years suggesting, beyond obvious methodological differences, that preferences and drinking patterns have changed.

McClure's estimation of daily fluoride intake (1943) was based on the assumption that drinking water fluoridated at 1 ppm formed 25 to 33 per cent of the intake; fluoridated water added to food during cooking processes formed ten to 20 per cent of the intake; and food contributed the remainder of the total intake. The average consumption of fluoride from all sources was estimated at 0.05 mg per kilogram of body weight for children of ages one to 12. McClure (1949) later provided analyses of the fluoride content of various foods and beverages including cow's milk and tea.

Galagan et al. (1957) provided a percentage distribution of each kind of fluid consumed by children from infancy to age 12 (Appendix A, Table 1). They found a significant negative correlation in one study area between atmospheric temperature and intake of fluids other than water, water-based beverages and carbonated beverages, and suggested that this may result from a decrease in milk consumption as atmospheric temperature increases and water and cooling drinks are substituted for milk.

Neumann (1957) emphasized the variability of tap water intake among children of New York and found that, among preschool children, the only other fluid consumed regularly was orange juice. Carbonated beverage consumption was low in this group; tea and coffee were of no

significance, and soups prepared with water were consumed by only one child in 40. No attempt was made to correlate atmospheric temperature with fluid intake.

Gray, Bonham and Luttrell (1964) investigated the correlation between the amount of fluoridated fluid consumed and the subsequent caries prevalence in 160 children living all their lives in a fluoridated community. Fluid intake information for each subject was collected by history and by a one-week record. The recorded current fluid intake pattern was presumed to have prevailed from age two to six unless changes of pattern were reported in the history. Caries prevalence was measured by the def index, an average of all def scores for the primary dentition. Each def score was obtained by summing the decayed teeth (d), teeth indicated for extraction (e), and filled teeth (f) of each child. No correlation was found between estimated fluoridated fluid intake from birth to six months and from six months to two years and the current caries attack rates. When the total number of children was divided into 'high' and 'low' fluoride intake groups, the average caries scores obtained were slightly lower for the high fluoride group. The range of total fluid intake of six year olds during winter months was extremely great - from 0.24 to 2.01 ounces per pound of body weight per day.

McPhail and Zacherl's findings (1965) were compared with Galagan et al. and are particularly relevant to this investigation. The major findings were related to total milk consumption, tap water consumption relative to atmospheric temperature, and the distribution of all fluids

consumed. Total milk consumption ranged from 68.13 per cent of total fluid intake in the under age one group to 40.64 per cent of total fluid intake in the age nine to ten group (Appendix A, Table 2). For ages five to 11, the average milk consumption of approximately 2 1/4 cups per day is slightly less than the later findings of 2 1/2 cups by Nutrition Canada (Nutrition Canada Report, 1977). The percentage distribution of all fluids consumed was compared with the Antioch-Brentwood studies of Galagan et al. and found to be very similar (Appendix A, Table 3). Tap water consumption relative to temperature was slightly higher in colder months than in warmer months but the means were not significantly different. McPhail and Zacherl suggested that their findings support those of Galagan et al. only for the range 82.3°F to 50°F. Below 50°F, water consumption increases due to the influence of indoor heating and, perhaps, warm winter clothing.

Myers, in his review of the literature (1978), agreed that fluoridated water was the largest contribution to daily fluoride intake. He also suggested that daily fluids were consumed in three different forms: as drinking water, as tap water used in the preparation of foods, and as non-tap water fluids. The amount of fluoride contributed by each form differed and varied with age.

The distribution of total fluid intake by age group was originally provided by McPhail and Zacherl in ounces per day per child. Myers (1978) converted these fluid ounces to milliliters per person per day. Further, he provided calculations of fluoride ingested from the 11 categories of fluid listed by assuming 1 ppm or using concentrations published by other investigators. A comparison of the

two tables is provided in Appendix A, Tables 4a and 4b.

Myers concluded that the fluoride contributed from all sources for ages one to ten varied directly with age from 0.450 to 1.0 mg per person per day. Moreover, total fluoride from all liquids provided 1 mg per day in the ten year old group. A general consensus among health professionals is that total dietary intake of fluoride, including liquids, should provide 0.05-0.07 mg of fluoride per kilogram of body weight (Singer & Ophaug, 1978).

Calculations of the fluoride content of foods and beverages have not always been consistent. Singer and Ophaug (1978) suggested that this inconsistency has been due to the degree of reliability of methods employed, lack of information about the use of fluoridated water in the processing of products, and inadequate sampling and sample preparation. For example, Singer and Ophaug, on the basis of other reports, suggested that cow's milk probably contains less than 0.05 ppm, and human milk, less than 0.1 ppm fluoride. Other investigators, however, reported 0.1-0.28 ppm in cow's milk and 0.1-0.2 ppm in human milk (Singer & Ophaug, 1978). These differences may be due to methodological variation or sampling procedures.

Marier and Rose (1966) investigated the effect of the use of fluoridated and non-fluoridated water supplies on the fluoride content of foods. They found that the use of fluoridated water in the processing of beverages and canned vegetables added, on the average, 0.5 ppm fluoride to the product. This study clearly illustrated the increasing difficulty of estimating dietary intake since food items produced in one area may be consumed in an area with quite different

fluoride concentration in the water.

Several authorities suggested that soft drinks, beverages, and juices are now being consumed in increasing quantities as a replacement for water (Singer & Ophaug, 1978; Schultz, 1976). As a snack, soft drinks ranked higher than white milk for 16-17 year old Ontario teenagers in a study of between-meal eating patterns by Beals et al. in 1981. In a longitudinal study of the dietary changes of a sample of Ontario children, Chao et al. (1984) examined the frequency of consumption of major food categories and found a considerable increase in the frequency of soft drink consumption and a decrease in milk consumption for males over a three year period from ages 11-12 to 14-15, although milk remained the most frequently consumed beverage.

Schultz (1976) found that the fluoride concentrations of carbonated beverages prepared with municipal water fluoridated at 1 ppm were just slightly less than this optimum concentration for drinking water, and that there were no differences between bottled and canned beverages. He suggested that the use of beverages bottled with fluoridated water would provide consumers with almost as much fluoride as would be obtained from tap water. Shannon (1977) also showed that the fluoride content of soft drinks, produced at several plants in Texas, approached the level of concentration of the fluoride in the drinking water.

A table prepared by Singer and Ophaug (1978) illustrates the variations in fluoride content of commonly consumed beverages reported by numerous investigators. (Appendix A, Table 5).

The most recent calculations of the fluoride content of foods and beverages are provided by the extensive analyses of Hargreaves (1984). The pertinent results are included in Appendix A, Table 6.

Dental Health in Camrose and Wetaskiwin

Following the establishment of the fluoridation of water supplies as an effective public health intervention for the prevention of dental caries, the testing of community water supplies received extensive attention. As a result of testing in Alberta in 1958, many communities were compared for differences and similarities. The difference between Camrose and Wetaskiwin was noteworthy; Camrose water averaged 0.23 ppm of natural fluoride while Wetaskiwin water contained 1.2 to 2.0 ppm of natural fluoride. Since the populations of Camrose and Wetaskiwin were the same size, interest was immediately focused on the dental health of the children born and raised in these two communities (Castaldi, Quigley, and Zacherl, 1963).

In the school term 1961-1962, all children in Camrose and Wetaskiwin who had been continuous residents since birth and who were attending elementary schools were given complete dental examinations. The findings relevant to the present study were the following: in Camrose the average number of decayed, extracted, and filled permanent teeth (DMFT) per child of age 11 was 6.1 teeth; in Wetaskiwin the average DMFT was 2.3 teeth (Castaldi, Quigley, & Zacherl, 1963).

Literature Pertinent to the Methodology

In an extensive review of dietary survey methodology, Marr stated that "There is no generally accepted method of measuring the dietary intake of free-living individuals" (Marr, 1971, p. 106). He suggested that the potential of each method must be assessed against the objectives of the study. Methodology in epidemiological studies involving large numbers must, of necessity, be pragmatic (Young & Trulson, 1960). Some considerations are reasonably obvious: the specific information desired, the time span involved, the method of collecting data, the determination of quantities, and the individual(s) responsible for reporting this information. The method used to collect dietary data is dependent upon the type of dietary information sought, both qualitative and quantitative. A comparison of the characteristics of three methodologies was provided in Volume One The Methodology of the Nutrition Needs Assessment Survey (Campbell, Craig & Rolf, 1980) and is reproduced here as Table 7 in Appendix A.

Young and Trulson (1960) also drew attention to the less obvious considerations of validity and reliability and suggested that fulfilling the requirements of both may be difficult in epidemiological surveys. They noted that evidence indicates greater accuracy - reliability - when the subject is aware of his intake. In contrast, the usual intake - validity - may best be obtained by observation and without the participation of the subject. Other factors which influence the validity of the information obtained from an individual include his degree of cooperation and comprehension and his ability to

estimate quantities and report them appropriately. Quality of data is also dependent upon the ability of the interviewer/researcher to establish rapport with the subject(s) and the clarity of instructions provided.

Marr (1971) proposed that precise weighing techniques are the "gold standard" of validity of measurement. Departures from the "gold standard," such as present intake recorded in household measures, or past intake recalled, influence validity. There is a loss of accuracy at each stage of dietary assessment as it is modified in order to make the process of evaluation more acceptable to a wider population.

Present intake recorded in household measures or compared in size with food models or containers results in a loss of precision from weighed intake but affords a higher degree of cooperation. With this method, supervision is not necessary but is highly desirable (Marr, 1971). A detailed interview prior to recording establishes the quantities and characteristics to be recorded; a post-recording interview confirms descriptions of intake as recorded.

The widely used dietary record of present intake has been subjected to considerable investigation regarding the minimum number of days required to assure validity, and which days are most representative of the usual intake. Weekend day analyses may differ significantly from those of weekdays. Increasing the number of days of recording may provide a better evaluation of customary intake of the individual but does not ensure that the recorded food consumption accurately reflects established patterns of intake (Beal, 1980). The interviewer/researcher must balance a sufficient period of time to

record an adequate profile of intake with the waning interest and cooperation of subjects who may succumb to the tediousness of a prolonged recording period (Young & Trulson, 1960).

The distinction between group and individual data must be clear; methods adequate to give mean intake of groups differ from those necessary for a valid measure of the characteristic intake of an individual (Young & Trulson, 1960). One and three day records of estimated quantities are sufficient for group means whereas precise weighing techniques for three to seven days are the preferred approach for an accurate assessment of the current intake of an individual (Marr, 1971). The primary value of dietary records is their use in comparative studies to suggest a need for further and more precise measurement or to provide a basis for program planning (Frankle & Owen, 1978).

CHAPTER III

MATERIALS AND METHODS

Selection of the Study Population

Selection of Non-Fluoridated and Fluoridated Communities

The requirements for the study population were considered to be children of appropriate age, accessibility, and exposure to fluoridated and non-fluoridated water supplies. Children of all ages up to 12 or 13 years old would be desirable but not practical with fixed time and cost constraints. The question of accessibility is no less a critical consideration given that preschool children are not readily accessible and parental involvement nearly inversely proportional to the age of the child would be required in any recording of information. The youngest and oldest elementary school children capable of writing were selected as the age groups which might provide the greatest range of results. Children aged 6-7 and 11-12 years or approximately grades two and six were chosen.

The selection of fluoridated and non-fluoridated population centers was also dependent upon reasonable size and accessibility. The two cities of Camrose and Wetaskiwin were selected for their proximity to each other and to Edmonton, their similarity in size of population, and their difference in providing non-fluoridated versus fluoridated water supplies. There were approximately 140 children in each grade in each city. About two-thirds or 100 were expected to give consent for

the recording of fluid intake and the dental examination. With a sample size of approximately 100 children in each city, a 95 per cent confidence level of ± 1.0 DMFT could be attained in the results of the dental examination for populations having a high prevalence of caries such as four or more DMFT at 12 years. For populations with a low prevalence of caries, the sample size could be reduced to one-half or less while maintaining precision limits within the range ± 0.5 - 1.0 DMFT (WHO, 1977).

Both Camrose and Wetaskiwin are located in agricultural regions. The June, 1984 Community Profiles published by Alberta Tourism and Small Business cite the populations of Camrose and Wetaskiwin as 12,809 and 10,022, respectively. Camrose is 88 km southeast of Edmonton and Wetaskiwin is 71 km south of Edmonton. Average seasonal temperatures vary less than 1°C between the cities in both February and June. The fluoride content of Camrose drinking water has been regularly monitored at 0.23 ppm; Wetaskiwin water has had an average adjusted fluoride content of 1.08 ppm since 1974. Prior to 1974, Wetaskiwin water was drawn from several wells with high natural fluoride content resulting in a fluctuation of levels from 1.2 to 2.0 ppm fluoride (Alberta Environment, 1984).

Acquisition of Consent

In November of 1983, meetings were arranged with the school superintendents and trustees of both public and separate school districts in Camrose and Wetaskiwin to describe the intended study and to secure consent. All four school districts gave permission to

approach parents for consent and to conduct the study through the schools. At the request of the Wetaskiwin authorities, grades two and six were selected in preference to ages 6-7 years and 11-12 years in order to minimize class disruption.

Letters requesting parental consent were distributed and collected by teachers in all schools. In several schools the letters were distributed just prior to the Christmas vacation. For those schools, a second consent letter was prepared and distributed when the children returned to school in January, 1984. A third consent letter was available to those students who indicated a desire to participate in the study during the classroom presentation preceding the first recording of fluid intake. Copies of the consent letters are included in Appendix B.

The role of the parents was not emphasized in any way. It was expected that by minimizing the requirement for parental involvement the number of parents giving consent would be maximized.

Development of the Instrument

The study was intended to estimate the beverage intake of groups of children by having each child use a standard container as a measurement guide and record his or her estimated intake for a predetermined period of time. Beverage was defined as any drink which included water, milk, whole juices, reconstituted juices, carbonated beverages, ades and punches, tea and coffee. Two non-beverage sources of fluid intake, cereal and soup, were included in order to assess the intake of milk and total intake more accurately. Other sources of

fluid intake such as gelatin desserts, pudding, and popsicles were not included. Beverage intake recorded in this manner is representative of the minimum fluid intake. Definitions of all beverage categories are included in Appendix C.

Based on the characteristics of a food record described in Table 7, Appendix A, a three-day beverage diary was designed for the recording of beverage intake including two weekdays and one weekend day. Three days were considered a sufficient period to allow for within person variation without requiring extreme motivation for completion (Marr, 1971, page 143; Beal, 1980, pp. 81, 82). The sample size was expected to be approximately 100 children in each city, large enough to minimize the effect of between person variation in a three-day record. The minimum sample required for representation of the population was considered to be at least 50 per cent of the selected age range.

Since the beverage intake record was intended for use by children rather than adults, the format and directions were designed for the instruction and motivation of the elementary school child. The record was entitled DRINK DIARY and the final version is included as Appendix D. The letter, included on pages two and three of the diary, had illustrated instructions for the recording of beverages using the container which was provided to each child as well as instructions on how to estimate beverages using other containers. The sample record on page four was illustrative of numerous drinks and drink combinations. The last page which listed the most common drinks, their sources and usual size of containers, could be used as a reference guide.

The container selected for use as the standard unit of measurement was a polypropylene container with oz and ml graduations. An accent line at 200 ml provided a distinctive measurement for one unit. Recordings in terms of whole units and partial units of one-quarter, one-half and three-quarters were illustrated in the diary letter and sample.

Pretest of the Instrument

Two pilot groups participated in the pretest of the instrument. The first group included six children of members of the Faculty of Dentistry, aged seven to 11 years. These children recorded their intake in December of 1983 using the first draft of the diary and the measuring container. The completed records were verified with the parents. The parents' and children's comments and suggestions for revision were noted. The youngest children were able to record reasonably accurately only with the assistance of their parents. The diary was modified and the decision was made to pretest the instrument with two classes of children in an Edmonton school.

Permission was obtained from the Edmonton Public School Board and the principal of McKee School to approach parents for consent and to conduct the pretest through the school. Parental consent was obtained for 21 grade two and 17 grade six children or 91.3 per cent and 62.9 per cent respectively, of the total number of children in these classes. Following a classroom lesson and demonstration in January of 1984, the children recorded their beverage intakes using the modified DRINK DIARY and the container. Of the grade two children, 16 or 69.6

per cent returned a completed diary. Of these, only 6 or fewer than half of the children completed the diary themselves. Clearly, most of the diaries had been completed by parents or guardians. Of the grade six children, 15 or 55.5 per cent returned a completed diary.

The information recorded in the diaries was verified with the children in the week immediately following their recording. Each child's height was recorded to the nearest half inch and weight to the nearest half pound. Individual beverage intake items, brands, and amounts were verified during small group discussions with the children. Particular emphasis was placed on amounts consumed using containers other than the one provided. Common household mugs, cups, and bowls, of varying sizes, were used to facilitate recall of containers used in the home. All children indicated difficulty in estimating water consumption at the school fountain without the aid of the container provided as the unit standard.

The difficulty encountered in verifying information with the grade two children was obviously related to their lack of recall and their limited involvement in the actual recording of intake. Attempts to verify information with the children would not be useful if the parents had completed the diary rather than assisting the child in his or her recording of information.

All children who returned a completed diary were given bookmarks as tokens of appreciation for their participation. The assistance and cooperation of the teachers and principal were also acknowledged.

The results of the grade six pretest are included in Appendix E.

Refinement of the Study Population

The diary was modified further and the decision was made to exclude grade two children on the basis of their inability to record intake accurately without considerable parental participation.

It was expected that the grade six children of Camrose and Wetaskiwin would be able to record about as well as the grade six children in the pilot test. A more extensive review of the literature on education and pretesting of the DRINK DIARY with grades three, four, and five would be necessary prior to selection of those age groups or grades for recording of beverage intake.

Data Collection

Survey of Beverage Retailers Supplying the Study Groups

Without assurance of the source of beverages, application of a range of fluoride from known beverages would not be possible. In January, 1984, a selection of merchants and retail outlets in Camrose and Wetaskiwin were surveyed in order to determine their source of supply for milk, juices and carbonated beverages. The results of this survey of 17 outlets is included as Appendix F.

All juices and carbonated beverages for both Camrose and Wetaskiwin were obtained from Edmonton. Established distribution routes for carbonated beverages in particular precluded the purchase of these products by Camrose and Wetaskiwin retailers from suppliers which might be nearer, or cheaper, than Edmonton suppliers. In Wetaskiwin, milk was supplied by both the local dairy, Northern Alberta Dairy Pool

(NADP), and Edmonton PALM Dairies. In Camrose, milk was supplied only by the local NADP dairy.

The source of supply for all beverages in Camrose and Wetaskiwin, other than water and some locally produced milk, was therefore known to be Edmonton.

Winter Recording

The recording by the study population was initiated during the first week of February, 1984. At the request of the grade six teachers and principals in all 12 Camrose and Wetaskiwin Schools, the 20-minute classroom lesson on beverage recording was presented for all students in the grade six classes rather than exclusively for students who had consent to participate in the study. The objective of the 'lesson' was to instruct the children in accurate recording by using the container and by estimating drinks consumed from other containers. Accuracy was stressed in terms of quantity and quality in order to minimize recording errors. Students were assured that all drinks consumed during the recording period were important but none were superior or inferior in any way. Variation among individuals in quantities consumed and preferences were noted as 'normal'. Appropriate visuals and a simple experiment were included as motivators.

The problem of estimating intake from water fountains was addressed by instructing the students to use the container provided or to estimate in one of the following ways. It was assumed that 'swallows' from the container would be comparable to 'gulps' from the water foundation. The child could therefore have a trial recording of

'swallows' from a pre-measured quantity and then use that number of 'swallows' as an equivalent for fountain 'gulps'. Alternatively, the child could expectorate a predetermined number of gulps into the container, note the quantity, and use that quantity as a gauge for future 'gulps'.

Children participating in the study were each given a container and a DRINK DIARY between February 6 and 14, 1984. The diaries were completed between February 9 and 11 in Camrose and February 16 and 18 in Wetaskiwin. The diaries were verified with the students in the week following their completion. At that time a portable meter stick with a right angle was used to measure height to the nearest half centimeter. Heights were measured with each subject standing with heels flat against a wall. A digital read-out scale was used to measure weight to the nearest half kilogram. The scale was always placed on concrete or hard tile before weights were taken. The displayed weight helped to maintain the interest of the students in the procedure since they could readily note their individual weights. Both measuring instruments had been pretested by comparison of readings with known measurements for accuracy and consistency $\pm$ 0.5 cm and kg. Care was taken in the transportation of the instruments and in ensuring similarity of circumstances of use in each school.

Small group discussions with the participating children were used to facilitate an exchange of ideas and information prior to assessment of individual diaries. A tally was taken of the number of children who recalled consuming any quantities of gelatin dessert, pudding, and popsicles during the recording period. Common household mugs, cups,

and bowls were used to aid in estimating quantities of beverages that had been consumed from containers other than the ones provided. Participants were encouraged to discuss any problems or uncertainties. Recordings of beverages were either verified as accurate or estimated by the interviewer to the nearest quarter unit - except for milk which, if added to tea or coffee, was estimated as 20 mls or 0.01 units. Perceived accuracy of recording was verbally rewarded regardless of the content of the recording.

All participants who completed the diary were given tokens of appreciation and reminded that the study was, in fact, a three-part study from their perspective. The same participants who completed the winter diary were asked to complete a diary in June. They also received a dental examination by one of two dentists who obtained the dental health data.

Estimation of Water Fountain Consumption

The problem of accurate estimation of water fountain consumption is impossible to resolve with certainty in any free-living group of children. An attempt was made, nonetheless, to determine a norm by estimating a class average. The 25 grade six students of Centennial School in Wetaskiwin agreed to participate in a brief demonstration of 'swallowing' and 'gulping' capacity. Initially, each child was provided with two containers, each with 100 ml of water, during the first class in the morning. Students were asked to drink as usual and record the number of 'swallows' required to completely consume the contents of each container. Secondly, each child took one container to

the water fountain. The first 12 children took three 'gulps' of water from the fountain and expectorated them into their containers, one gulp at a time. The next 13 children took five 'gulps' of water from the fountain and expectorated them into their containers, one gulp at a time. Later in the morning, just prior to lunch at a time when the children's natural drinking capacity might be expected to have returned, the students again consumed 100 ml of water and counted their swallows to completion.

The results of this demonstration are included in Appendix G.

Summer Recording

The second recording by those participants who completed the winter diary was undertaken in the first week of June, 1984. Some preliminary results from the winter recording were incorporated into a second 20-minute classroom lesson intended as a review of the instructions for recording beverage intake. Individual estimation of intake from the water fountain was carefully reviewed. Once again, at the request of all the teachers involved, the lesson was presented to the entire class rather than for the participants only. Students, teachers, and principals were obviously interested in the progress of the study and encouraged the use of classroom time for discussion.

Participants were given a container and a DRINK DIARY in the period from May 28 to 30, 1984. The diaries were completed May 31 to June 2 by the majority of students, with very few recording intake in the following two weeks. The diaries were verified with the students in the two weeks following their completion; the delay beyond one week

was unavoidable. Since reliability might be expected to decrease with an increase in the time span between recording and vertification, additional time and care were taken in the verification of those diaries which had been completed for longer than one week. The results, in terms of perceived accuracy of recording, were satisfactory. Height and weight data were again recorded as well as a tally of any recalled consumption of gelatin dessert, pudding, and popsicles.

The participants expressed confidence and demonstrated expertise in their recordings during the small group discussions and individual verifications. Less time and effort were required to ensure reasonable understanding and accuracy of recording with each participant than following the winter recording.

All students who completed the summer recording were given tokens of appreciation and reminded of the forthcoming dental examination by the dentist. Their participation in the study and their completion of two diaries were commended.

Dental Health Data

Dr. W.G. Thompson, Dean of the Faculty of Dentistry, and Dr. J.A. Hargreaves, Director of Graduate Studies and Research, examined the study population during June, 1984. Interexaminer variation between the two dentists was known to be minimal from previous dental surveys and calibrations (Hargreaves, Thompson & Wagg, 1983). A copy of the dental examination record is included in Appendix H.

Four oral health indices were selected for the comparison of

children in Camrose and Wetaskiwin: gingivitis, oral hygiene, decayed-extracted-filled permanent teeth (DMFT), and decayed-extracted-filled permanent surfaces (DMFS). These indices are widely accepted indicators of oral health and are described by Hargreaves et al. (1983). The gingivitis index was that of Loë and Silness (1963). The oral hygiene index was the modified debris index of Greene and Vermilion (1964). The caries index DMF was first described by Klein, Palmer and Knutson (1938). Both DMFT and DMFS were described by World Health Organization (1977); criteria for diagnosis and coding are well established.

Data Analysis

The sex, age, height, weight and beverage intakes of participants, as recorded in the winter and summer diaries, were coded and entered into a computer format. Each participant was also coded for city and school.

Dental health epidemiological data was coded by the examiners and recorders at the time of examination. The coded data was entered into a computer format.

All coding for beverage intake and all data entry for both intake and dental health were completed by the author. Subsequent checks for errors revealed negligible error during data entry. Error correction was assured prior to the final analysis.

The analyses of Hargreaves as outlined in Appendix A, Table A-6, were used to assign fluoride values to the maximum and minimum

three-day total beverage intakes in both cities.

The computer program statistical package, SPSS-X, was used to determine group means by city, season, and sex. Within and between group variation was examined by one-way ANOVA. Scattergrams and Pearson Product-Moment Coefficients of Correlation were computed for examination of correlation between beverage intake and dental indices.

CHAPTER IV

RESULTS

Characteristics of the Study Populations

Participants as Proportions of the Total Population

Approximately 60 per cent of the total number of grade six children in Camrose and Wetaskiwin participated in the recording of beverage intake. The proportions for winter and summer and the per cent of the total grade six population are shown in Table 1.

Physical Attributes of the Study Groups

The mean age, height, and weight of the study groups by city, sex, and season are shown in Table 2. Although males were slightly older than females in both cities, and there was some variation in age, height, and weight, by sex and city, there were no significant differences among the physical attributes of the groups in the study.

Atmospheric Temperature

Environment Canada provided the following atmospheric temperatures for Camrose and Wetaskiwin, representative of winter and summer. The monthly means for February 1984 were -2.8°C for Camrose and -2.7°C for Wetaskiwin. The 20-year normal temperatures were -11.6°C for Camrose and -11.4°C for Wetaskiwin. For June 1984, the means were 14.5°C for Camrose and 14.0°C for Wetaskiwin; the 20-year normal temperatures were 14.4°C for Camrose and 14.1°C for Wetaskiwin.

Table 1

Participants as proportions of the total grade six population

	Winter	Summer
Camrose (non-fluoridated)		
Females	61	58
Males	58	53
Study Group	119	111
Per Cent of Total Population	63.3%	59.0%
Wetaskiwin (fluoridated)		
Females	45	39
Males	49	46
Study Group	94	85
Per Cent of Total Population	64.4%	58.2%

Table 2

Physical attributes of Camrose (non-fluoridated) and Wetaskiwin (fluoridated) females and males in winter and summer

Intake Recordings		Variables: age* Mean ± sd	n	height** Mean ± sd	n	weight *** Mean ± sd	n
WINTER							
Camrose	F[1]	11.71±0.53	61	149.1±7.6	61	41.6±11.7	61
	M[2]	11.96±0.76	58	150.1±7.4	56	42.0± 8.7	56
	T[3]	11.84±0.67	119	149.5±7.4	117	41.6±10.2	117
Wetaskiwin	F[1]	11.69±0.60	45	149.7±6.3	45	41.0± 7.3	45
	M[2]	11.77±0.59	49	149.9±6.6	49	41.9± 8.4	49
	T[3]	11.74±0.59	94	149.8±6.4	94	41.5± 7.9	94
SUMMER							
Camrose	F[1]	12.05±0.54	58	151.6±7.0	58	43.2±11.8	58
	M[2]	12.25±0.72	53	152.3±6.6	53	43.6± 8.4	53
	T[3]	12.15±0.63	111	151.9±6.8	111	43.4±10.2	111
Wetaskiwin	F[1]	11.98±0.59	39	151.6±6.6	38	42.6± 8.0	38
	M[2]	12.11±0.60	46	151.4±6.9	44	43.0± 8.9	44
	T[3]	12.05±0.60	85	151.5±6.7	82	42.8± 8.4	82
ALL WINTER		11.80±0.64	213	149.6±7.0	211	41.6± 9.2	211
ALL SUMMER		12.11±0.62	196	151.8±6.7	193	43.1± 9.5	193
TOTAL		11.94±0.65	409	150.6±6.9	404	42.3± 9.4	404

* age = age in years
** height = height in centimeters
*** weight = weight in kilograms

[1] = females, [2] = males, [3] = total (1 + 2)

Beverage Intake

Beverage Intake by Season

The collective beverage intakes of grade six students in the non-fluoridated (Camrose) and fluoridated (Wetaskiwin) areas for winter and summer are shown in Tables 3 and 4. Mean consumption is provided in units of 200 ml with the standard deviation and number of participants who reported consumption of each beverage category. The beverage categories are rank ordered by frequency of consumption for the mean intake for three days clearly demonstrating beverage preferences by category and amount. The major variations in ranking by season were that soup and whole juice were consumed in greater amounts than tea in winter, whereas in summer, tea was consumed more frequently than soup and whole juice. The means of three-day intake actually decreased from winter to summer in the beverage categories of water, milk, reconstituted juice (commercially prepared), whole juice, soup, and other. The increases in means from winter to summer were in the categories of reconstituted juice (home prepared), carbonated beverages, tea, coffee, and miscellaneous. Overall, there was a decrease in the mean consumption from winter to summer shown by the means of daily totals for Thursday, Friday, and Saturday, and the mean three-day intakes.

An analysis of variance showed that none of the mean differences for any beverage category on any day, or for a total of three days, between winter and summer, were significant.

Table 3

Winter beverage intake of grade six students by day

Beverage Category	Mean consumption by day** Thursday Mean ± sd	n	Friday Mean ± sd	n	Saturday Mean ± sd	n	Intake for Three Days Mean ± sd	n
Milk	2.35±1.56	186	2.47±1.56	181	2.59±1.84	171	6.51±4.12	204
Water	2.18±1.95	175	2.09±1.88	154	2.00±1.81	121	4.80±4.69	197
Carb. bev.*	1.54±0.79	64	1.99±1.31	97	2.17±1.35	112	3.44±2.57	155
Other*	1.94±1.22	70	1.83±1.01	55	2.09±1.62	75	3.58±2.69	110
Reconst. j. (h)*	1.90±1.26	47	1.46±0.89	48	1.44±1.05	45	2.64±1.95	84
Reconst. j. (c)*	1.68±1.61	42	1.75±1.00	51	1.54±0.78	29	2.64±2.17	77
Whole juice	1.07±0.55	27	1.45±0.93	20	2.56±3.45	18	2.63±3.06	38
Soup	0.99±0.43	31	1.26±0.70	20	1.36±0.95	22	1.48±0.99	56
Tea	1.54±0.53	12	1.30±0.44	10	1.90±1.37	12	2.47±1.86	22
Misc.*	0.81±0.43	4	1.42±0.52	3	1.60±0.84	10	1.57±1.13	15
Coffee	1.67±0.29	3	1.05±0.11	5	1.18±0.64	7	1.55±0.94	11
All Beverages	6.09±2.35	213	6.08±2.69	213	6.21±2.84	213	18.35±6.09	213

** Consumption in units (1 unit = 200 ml)

* Abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table 4

Summer beverage intake of grade six students by day

Beverage Category	Mean consumption by day** Thursday Mean ± sd	n	Friday Mean ± sd	n	Saturday Mean ± sd	n	Intake for Three Days Mean ± sd	n
Milk	2.39±1.35	180	2.32±1.47	175	2.40±1.63	155	6.34±3.73	191
Water	1.98±1.59	144	1.86±1.66	130	2.14±1.54	107	4.39±3.76	172
Carb. bev.*	1.71±0.85	60	2.10±1.27	105	2.29±1.50	123	3.80±2.71	159
Other*	1.77±1.11	73	2.18±1.46	55	2.25±1.64	61	3.51±3.20	110
Reconst. j. (h)*	1.60±1.03	41	1.73±1.33	41	1.34±0.83	36	2.80±2.36	66
Reconst. j. (c)*	1.33±0.36	23	1.55±0.70	21	1.46±0.68	19	2.39±1.45	38
Tea	1.76±0.84	22	1.23±0.72	15	1.73±0.78	20	2.55±1.65	36
Whole juice	1.44±0.69	12	1.26±0.67	17	1.25±0.62	15	1.98±1.25	29
Misc.*	1.22±0.86	8	1.35±1.09	13	1.65±1.04	18	1.68±1.69	34
Soup	1.24±0.51	24	1.19±0.29	13	0.97±0.20	9	1.32±0.60	41
Coffee	1.65±1.64	5	2.25±1.06	2	1.31±0.58	8	2.33±2.51	10
All Beverages	5.87±2.28	196	5.96±2.71	196	6.11±2.92	196	17.94±6.50	196

** Consumption in units (1 unit = 200 ml)

* Abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Beverage Intake by City

Tables 5 to 8 show the winter and summer beverage intake of non-fluoridated (Camrose) and fluoridated (Wetaskiwin) cities. The ranking of beverages by frequency of consumption varies slightly except for the top four categories: milk, water, carbonated beverages, and other beverages prepared by adding tap water in the home.

Tables 5 and 6 do show a difference of more than one unit in water consumption for the three-day winter period. Wetaskiwin students consumed less water than Camrose students but the difference was not significant. Tables 7 and 8 show the summer intake of water. Camrose students consumed slightly less water than Wetaskiwin students but, again, these were not significantly different.

The greatest mean intake of carbonated beverages by students in Camrose was on Friday in both winter and summer whereas in Wetaskiwin, the greatest mean intake was on Saturday in both winter and summer. The greatest daily mean in Camrose was on Friday in both winter and summer whereas in Wetaskiwin, the greatest daily mean was on Saturday in both winter and summer.

An analysis of variance was computed for differences between the non-fluoridated and fluoridated cities in winter, in summer, and collectively in winter and summer. The mean intakes by city were not significantly different for the daily means or three-day means of any beverage category except for home prepared reconstituted juice. The three-day intake of this beverage was significantly greater in Camrose than in Wetaskiwin ($p < 0.01$).

Table 5

Winter beverage intake by day of grade six students in a non-fluoridated city (Camrose)

Beverage Category	Mean consumption by day** Thursday Mean ± sd	n	Friday Mean ± sd	n	Saturday Mean ± sd	n	Intake for Three Days Mean ± sd	n
Milk	2.36±1.48	105	2.42±1.48	104	2.55±1.81	97	6.56±3.87	114
Water	2.39±2.13	95	2.26±2.09	90	2.22±2.06	72	5.26±5.28	112
Other*	1.82±1.08	45	2.00±1.21	34	2.24±1.91	48	3.85±2.87	67
Carb. bev.*	1.29±0.71	31	2.11±1.35	49	2.06±1.35	54	3.33±2.53	76
Reconst. j. (h)*	2.02±1.40	32	1.53±0.97	34	1.42±1.13	29	2.92±2.11	54
Reconst. j. (c)*	1.96±2.35	17	1.58±0.64	23	1.58±0.95	10	2.58±2.37	32
Soup	1.05±0.45	20	1.17±0.66	12	1.53±1.10	15	1.54±0.99	35
Whole juice	1.04±0.57	12	1.43±0.94	14	1.88±1.17	10	2.36±1.67	20
Tea	1.55±0.57	5	1.00	1	1.64±0.85	7	2.03±1.27	10
Misc.*	0.67±0.38	3	2.00	1	1.58±1.07	6	1.50±1.33	9
Coffee	1.00	1	1.00	2	0.25	1	1.08±0.88	3
All Beverages	6.21±2.52	119	6.30±2.89	119	6.24±3.00	119	18.75±6.48	119

** Consumption in units (1 unit = 200 ml)

* Abbreviations:

- Other = other tap water added to prepare ades or punches
- Carb. bev. = carbonated beverages
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table 6

Winter beverage intake by day of grade six students in a fluoridated city (Wetaskiwin)

Beverage Category	Mean consumption by day** Thursday Mean ± sd	n	Friday Mean ± sd	n	Saturday Mean ± sd	n	Intake for Three Days Mean ± sd	n
Milk	2.34±1.66	81	2.53±1.66	77	2.64±1.90	74	6.45±4.44	90
Water	1.93±1.68	80	1.84±1.52	64	1.68±1.30	49	4.20±3.72	85
Carb. bev.*	1.77±0.80	33	1.88±1.27	48	2.27±1.34	58	3.54±2.62	79
Other*	2.16±1.43	25	1.55±0.72	21	1.81±0.86	27	3.15±2.35	43
Reconst. j. (c)*	1.49±0.79	25	1.90±1.21	28	1.53±0.70	19	2.68±2.04	45
Reconst. j. (h)*	1.65±0.92	15	1.30±0.65	14	1.48±0.90	16	2.15±1.53	31
Whole juice	1.10±0.54	15	1.50±1.00	6	3.41±5.06	8	2.93±4.13	18
Tea	1.54±0.55	7	1.33±0.45	9	2.25±1.95	5	2.83±2.22	12
Soup	0.89±0.39	11	1.41±0.79	8	1.00±0.38	7	1.38±0.99	21
Coffee	1.25±0.35	2	1.08±0.14	3	1.33±0.54	6	1.72±0.96	8
Misc.*	1.25	1	1.13±0.18	2	1.63±0.48	4	1.67±0.86	6
All Beverages	5.94±2.13	94	5.80±2.41	94	6.17±2.64	94	17.85±5.55	94

** Consumption in units (1 unit = 200 ml)

* Abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Reconst. j. (h) = reconstituted juice, home prepared
- Misc. = miscellaneous

Table 7

Summer beverage intake by day of grade six students in a non-fluoridated city (Camrose)

Beverage Category	Mean consumption by day** Thursday Mean ± sd	n	Friday Mean ± sd	n	Saturday Mean ± sd	n	Intake for Three Days Mean ± sd	n
Milk	2.37±1.34	101	2.46±1.54	96	2.28±1.30	84	6.32±3.52	106
Water	2.02±1.77	80	1.88±1.89	74	2.18±1.59	56	4.27±4.28	99
Carb. bev.*	1.59±0.75	34	2.27±1.23	56	2.12±1.29	74	3.67±2.54	92
Other*	1.74±0.95	46	2.08±1.22	33	2.25±1.40	37	3.52±2.62	66
Reconst. j. (h)*	1.79±1.21	25	2.00±1.57	24	1.36±0.93	19	3.20±2.67	37
Tea	1.83±0.93	13	1.36±0.80	11	1.93±0.91	10	2.90±1.93	20
Reconst. j. (c)*	1.33±0.39	12	1.50±0.64	9	1.43±0.59	11	2.38±1.53	19
Misc.*	1.67±0.98	6	1.64±1.32	7	1.82±1.09	14	2.00±2.00	22
Whole juice	1.50±0.76	7	1.14±0.57	11	1.31±0.80	8	1.86±1.06	18
Soup	1.23±0.54	13	1.11±0.20	7	0.97±0.20	9	1.30±0.57	25
Coffee	1.92±2.24	3	2.25±1.06	2	1.25±0.74	4	2.54±3.28	6
All Beverages	5.96±2.29	111	6.16±2.94	111	5.99±2.88	111	18.10±6.72	111

** Consumption in units (1 unit = 200 ml)

* Abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table 8

Summer beverage intake by day of grade six students in a fluoridated city (Wetaskiwin)

Beverage Category	Mean consumption by day** Thursday Mean ± sd	n	Friday Mean ± sd	n	Saturday Mean ± sd	n	Intake for Three Days Mean ± sd	n
Milk	2.42±1.36	79	2.15±1.38	79	2.53±1.95	71	6.36±4.00	85
Water	1.94±1.33	64	1.82±1.29	56	2.09±1.49	51	4.55±2.94	73
Carb. bev.*	1.87±0.95	26	1.90±1.30	49	2.55±1.76	49	3.98±2.94	67
Other*	1.81±1.35	27	2.34±1.78	22	2.24±1.99	24	3.51±3.94	44
Reconst. j. (h)*	1.31±0.60	16	1.34±0.78	17	1.32±0.74	17	2.28±1.80	29
Reconst. j. (c)*	1.32±0.34	11	1.58±0.76	12	1.50±0.82	8	2.39±1.41	19
Tea	1.67±0.74	9	0.88±0.25	3	1.53±0.62	10	2.11±1.11	16
Whole juice	1.35±0.65	5	1.50±0.82	6	1.18±0.37	7	2.18±1.55	11
Soup	1.25±0.50	11	1.29±0.37	6			1.34±0.66	16
Misc.*	1.38±0.53	2	1.00±0.69	6	1.06±0.59	4	1.08±0.60	12
Coffee	1.25±0.35	2			1.38±0.48	4	2.00±0.82	4
All Beverages	5.76±2.28	85	5.69±2.38	85	6.27±2.97	85	17.72±6.24	85

** Consumption in units (1 unit = 200 ml)

* Abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Beverage Intake by Gender

Although gender was not considered a variable pertinent to the hypotheses of this investigation, numerous significant differences were discovered when the results were compared by sex. Appendix I contains the tables of beverage intake of females and males by city, season, and day. Mean consumption is expressed in units of 200 ml. The standard deviation, range of intake, and number of students who recorded beverage consumption are tabulated. Tables I-1-A to I-1-C show the winter intake of Camrose females and males by day. Table I-1-D is a mean of the total consumption in each category for three days. Similarly, Tables I-2-A to 1-2-D record Wetaskiwin winter intake and Tables I-3-A to I-4-D provide the results of summer intake for Camrose and Wetaskiwin. The city intakes are then combined for comparison of females and males by day in winter in Tables I-5-A to I-5-D, and summer in Tables I-6-A to I-6-D.

Ranking by frequency of consumption for the top four beverage categories was consistent with that in Tables 3 to 8. The range of intake for all categories was considerable. The means for water, milk and other were nearly always greater among males whereas the means for carbonated beverages were about the same for females and males. For all days in any three-day period, the means of daily totals were consistently greater among males. Males, however, showed no consistent pattern in means of daily totals from Thursday to Saturday whereas females showed slight increases in means for Thursday to Saturday except for Camrose females in the summer. With the few exceptions noted, these patterns of intake for males and females were consistent

regardless of city or season.

Variation in mean intake by sex is significantly different for several three-day mean beverage categories. Tables 9-A and 9-D show the significant differences between females and males in the winter, and in the summer, in Camrose and Wetaskiwin. Table 9-A shows that in the winter all males consumed significantly more water ($p = 0.0024$) and all beverages over three days ($p = 0.0095$) than did females.

Table 9-B shows that in the summer all males consumed significantly more water ($p = 0.0049$), milk ($p = 0.0000$), and all beverages for three days ($p = 0.0003$) than females.

Table 9-C combines winter and summer intakes in Camrose. It shows that males consumed significantly more water ($p = 0.0001$), milk ($p = 0.0053$), and all beverages for three days ($p = 0.0000$) than females.

Similarily, within Wetaskiwin, males consumed significantly more milk ($p = 0.0031$) than females (Table 9-D).

Other Sources of Fluid Intake

The number of children who reported consuming gelatin desserts, pudding, or popsicles at any time during winter and summer is shown in Table 10. The total amount of fluid consumed as gelatin desserts and pudding was very similar for both Camrose and Wetaskiwin in both winter and summer. These amounts demonstrate that fluid intake from these sources in minimal. More students in Wetaskiwin than in Camrose reported consuming popsicles in the winter; however, there was no difference between the two cities during the summer. Significantly more students reported eating popsicles during the summer than during

Table 9-A

Three-day water and all beverage intakes by females and males in winter

Three-day Intake	n	Mean consumption in units** Mean ± sd	Range	95 Per cent Confidence Interval	F Probability
Water	F 100	3.80±3.96	0.25 -27.75	3.01 to 4.58	0.0024
	M 97	5.81±5.16	0.50- 26.25	4.77 to 6.85	
All Beverages	F 106	17.24±5.60	4.75- 45.00	16.16 to 18.32	0.0095
	M 107	19.39±6.35	8.00- 41.50	18.17 to 20.61	

** 1 unit = 200 ml

Table 9-B

Three-day water, milk, and all beverage intakes by females and males in summer

Three-day Intake	n	Mean consumption in units** Mean ± sd	Range	95 Per cent Confidence Interval	F Probability
Water	F 82	3.55±2.93	0.25- 12.00	2.91 to 4.19	0.0049
	M 90	5.15±4.26	0.25 -19.50	4.26 to 6.04	
Milk	F 96	5.18±3.00	0.50- 12.50	4.57 to 5.78	0.0000
	M 95	7.52±4.04	1.00 -21.25	6.70 to 8.34	
All Beverages	F 97	16.27±5.77	7.35- 39.75	15.11 to 17.44	0.0003
	M 99	19.57±6.79	9.75- 50.75	18.21 to 20.92	

** 1 unit = 200 ml

Table 9-C

Three-day water, milk, and all beverage intakes by females and males in Camrose

Three-day Intake	n	Mean consumption in units** Mean ± sd	Range	95 Per cent Confidence Interval	F Probability
Water	F 106	3.48±3.70	0.25- 27.75	2.74 to 4.19	0.0001
	M 105	6.10±5.49	0.50 -26.25	5.03 to 7.17	
Milk	F 116	5.78±3.24	0.50- 19.00	5.18 to 6.38	0.0053
	M 104	7.16±3.03	0.20 -20.50	6.38 to 7.95	
All Beverages	F 119	16.55±5.57	4.75- 45.00	15.53 to 17.56	0.0000
	M 111	20.40±7.00	9.25- 50.75	19.08 to 21.71	

** 1 unit = 200 ml

Table 9-D

Three-day milk intake by females and males in Wetaskiwin

Three-day Intake	n	Mean consumption in units** Mean ± sd	Range	95 Per cent Confidence Interval	F Probability
Milk	F 83	5.42±3.19	0.20- 13.50	4.72 to 6.12	0.0031
	M 92	7.30±4.82	1.00 -24.00	6.30 to 8.27	

** 1 unit = 200 ml

Table 10

Fluid intake from three food sources by number of children indicating any consumption in three days

		Foods		
		Gelatin Dessert	Pudding	Popsicles
Winter	Camrose	5	8	1
	Wetaskiwin	6	9	8
Summer	Camrose	4	5	27
	Wetaskiwin	4	7	26

the winter.

Range of Fluoride Intake Based on Beverage Intake

In each of the two cities, the DRINK DIARIES of the students with the three highest and lowest total beverage intakes for three days were selected for calculation of the amount of fluoride which would likely have been available to them. The daily mean of each beverage category and the reported consumption was assigned a value for fluoride based on the analyses of Hargreaves (Appendix A, Table A-6). Results shown in Tables 11 and 12 demonstrate the range of fluoride available through beverage consumption. Variation in fluoride availability was dependent on the beverage category as well as the quantity consumed.

Dental Health

Oral Health Indices in Camrose and Wetaskiwin

The oral health of 115 children in Camrose (57 females, 58 males) and 89 children in Wetaskiwin (43 females, 46 males) was examined. All of these children had completed the winter drink diary; 192 had completed both winter and summer diaries.

The results of the examinations are summarized in Table 13. Four oral health indices were used to compare the oral health of the children in both cities: gingivitis, oral hygiene, permanent decayed-missing (owing to caries)-filled teeth (DMFT), and permanent decayed-missing (owing to caries)-filled surfaces (DMFS).

One-way analysis of variance was computed to determine

Table 11

Daily mean of highest three-day total beverage intakes and corresponding available fluoride for three grade six students in each of non-fluoridated and fluoridated cities

Student	Non-fluoridated A	B	C	Fluoridated A	B	C
Milk	1067 [1]	817	533	1600	333	1150
	0.03 [2]	0.02	0.02	0.05	0.01	0.03
Water	1150	1850	1267	-	233	233
	0.26	0.43	0.07		0.25	0.25
Carb. bev.*	100		867	1167	167	400
	0.08		0.69	0.93	0.13	0.32
Other*	400	333			1634	
	0.09	0.08			1.76	
Reconst. j. (h)*	667		200		200	333
	0.14		0.04		0.21	0.35
Reconst. j. (c)*	667		200		200	333
	0.14		0.04		0.21	0.35
Whole juice						
Tea						
Soup					83	
					0.09	
Misc.*						
Coffee						
Total	3383	3000	2867	2767	2650	2117
	0.60	0.53	0.82	0.98	2.45	0.95

** Consumption in units (1 unit = 200 ml)

* Abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

1 = daily mean of three-day intake in ml

2 = probable fluoride available in ppm

Table 12

Daily mean of lowest three-day total beverage intakes and corresponding available fluoride for three grade six students in each of non-fluoridated and fluoridated cities

Student	Non-fluoridated A	Non-fluoridated B	Non-fluoridated C	Fluoridated A	Fluoridated B	Fluoridated C
Milk	267 [1]	167	83	73	117	167
	0.01 [2]	0.01	0.00	0.00	0.00	0.01
Water		100		67	217	167
		0.02		0.07	0.23	0.18
Carb. bev.*			433	200		267
			0.35	0.16		0.21
Other*				67		
				0.07		
Reconst. j. (h)*	50	200				
	0.01	0.04				
Reconst. j. (c)*						
Whole juice						
Tea				83		
				0.18		
Soup					200	
					0.21	
Misc.*						
Coffee						
Total	317	467	517	490	533	600
	0.02	0.07	0.35	0.89	0.44	0.40

** Consumption in units (1 unit = 200 ml)

* Abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

1 = daily mean of three-day intake in ml

2 = probable fluoride available in ppm

Table 13

Oral health indices of grade six students in non-fluoridated and fluoridated cities

City	Indices*	Mean ± sd	n
Non-fluoridated (Camrose)	gingivitis	0.69 ± 0.34	115
	oral hygiene	0.71 ± 0.34	115
	DMFT	2.39 ± 2.14	115
	DMFS	3.40 ± 3.50	115
Fluoridated (Wetaskiwin)	gingivitis	0.58 ± 0.28	89
	oral hygiene	0.79 ± 0.36	89
	DMFT	2.80 ± 2.48	89
	DMFS	3.77 ± 3.81	89

*Indices = gingivitis, Löe and Silness

oral hygiene (Modified debris index), Green and Vermilion

DMFT/DMFS, WHO

significant differences in oral health indices by city and sex. There were no significant differences between the non-fluoridated (Camrose) and fluoridated (Wetaskiwin) cities for gingivitis, oral hygiene, DMFT, and DMFS.

There were significant differences between females and males. All males had a significantly greater DMFT than all females ($p < 0.05$). Males had a significantly higher index in oral hygiene - poorer oral hygiene - than females in Camrose and in Wetaskiwin ($p < 0.05$). Collectively as well, all males showed significantly poorer oral hygiene compared with all females ($p < 0.01$).

Caries Indices by Years of Residency

The exact number of years of residency was known for 114 children in Camrose and 81 children in Wetaskiwin. The caries indices, DMFT and DMFS, for less than five and five or more years of residency in Camrose and Wetaskiwin are provided in Table 14. The proportion of Camrose children residing in that city for five or more years was 67.0 per cent of the number examined; the proportion of Wetaskiwin children residing in that city for five or more years was 59.6 per cent of the number examined.

One-way analysis of variance for Camrose indicated that there were no significant differences between the two residency groups in either DMFT or DMFS. Wetaskiwin, however, showed significant differences between the two groups for both caries indices. Those children resident in Wetaskiwin for five years or more had a significantly lower DMFT ($p < 0.05$) and a significantly lower DMFS ($p <$

Table 14

Caries indices by years of residency in non-fluoridated and fluoridated cities

City	Index	Years of Residence	Mean ± sd	n
Non-fluoridated (Camrose)	DMFT	< 5	2.32 ± 2.26	37
		> 5	2.43 ± 2.11	77
		All known	2.39 ± 2.15	114
	DMFS	< 5	3.51 ± 3.71	37
		> 5	3.35 ± 3.44	77
		All known	3.40 ± 3.51	114
Fluoridated (Wetaskiwin)	DMFT	< 5	3.39 ± 1.97*	28
		> 5	2.26 ± 2.43*	53
		All known	2.65 ± 2.34	81
	DMFS	< 5	4.96 ± 3.98**	28
		> 5	2.79 ± 3.15**	53
		All known	3.54 ± 3.58	81

* Differences significant ($p < 0.05$)
** Differences significant ($p < 0.01$)

0.01) than children resident there for fewer than five years.

One-way analysis of variance in DMFT and DMFS of those children resident in their respective cities for five or more years indicated no significant differences between Camrose and Wetaskiwin.

Relationship of Beverage Intake and Dental Health

Scattergrams and Pearson Product Moment Correlation Coefficients were computed to determine the correlation between the three-day means, by city and sex, for all beverage categories and the caries indices, DMFT and DMFS. No significant correlation was evident from the scattergrams. Of the four beverage categories with the greatest mean intake - water, milk, carbonated beverages, and other beverages made with tap water - the most significant correlation was between carbonated beverages and DMFS of Wetaskiwin males at + 0.45 ($p < 0.001$).

CHAPTER V

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Interpretation of Results

Beverage Intake in Winter and Summer

The types of drinks contributing to the fluid intake of a population of children in winter and summer may be described in terms of categories of drinks and their rankings by frequency of consumption, mean daily intake by category and of total fluids, variability of intake, and the effect of atmospheric temperature on fluid intake.

Beverages Defined. Beverage categories in this study have been defined. Because of its potential as a source of fluid intake, soup was considered a beverage in this study. Juices were defined by composition: whole juices, those reconstituted commercially, or those reconstituted at home by the addition of tap water. Based on pretest results, milk required no further definition. Current beverage intake for all categories as defined in this study, in particular those for juices and milk, reflected the pretest results.

The results support the categories as defined. No children reported consuming reconstituted milk, but the reported frequency of consumption of commercially prepared reconstituted juices was about three-fourths that of home prepared reconstituted juices.

Beverages Rank Ordered by Frequency of Consumption. The top four beverages ranked in order of frequency of consumption and mean

consumption were milk, water, carbonated beverages, and other beverages prepared by adding tap water. The ranking of milk as the greatest single contributor to total fluid intake was in keeping with the results of Galagan et al. (1957) for age 9-10, and Chao et al. (1984) for age 11-12 to 14-15, although McPhail and Zacherl (1965) found that drinking water was consumed in greater quantity than milk for age 9-10. The three-day mean milk intake of 6.43 units would provide a daily milk intake of 429 ml or about 1 3/4 cups in contrast to McPhail and Zacherl (1965) who reported 2 1/4 cups for age 9-10, and Nutrition Canada (1977) which reported 2 1/2 cups consumed by those aged 5-11. Both Galagan et al. (1957) and McPhail and Zacherl (1965) found that carbonated beverages contributed a smaller percentage of total fluid intake than did the other tap water prepared beverages. The increase in carbonated beverage consumption noted here is in keeping with the more current findings of Beals et al. (1981), Pao (1981), and Chao et al. (1984). It is potent affirmation of the Canadian Soft Drink Association report of a 110 per cent increase in soft drink sales in Alberta from 1972 to 1981 (Hargreaves, 1982).

The remaining categories of beverages were distinctive in several respects. The frequency of consumption of commercially prepared reconstituted juice, indicates the popularity of this choice of beverage, particularly in relation to whole juice. This category could, however, contain ades and punches as these were not identified and eliminated from the data. The miscellaneous category included such items as 'slushes' (drinks prepared by adding carbonated beverage syrup to blended ice), wine, and commercially prepared products which

defy both description and categorization. Tea, soup, and whole juice are discussed further with reference to atmospheric temperature and season.

Mean Fluid Intake. Mean daily intake of all beverages was lowest on Thursday, highest on Saturday, and taken as a proportion of the three-day mean, was 1,211 ml. This mean intake is in agreement with Walker (1963) who reported a 1,247 ml daily intake for age 12; is somewhat less than the 1,310 ml daily intake for age 10 found by McPhail and Zacherl (1965) and the 1,537 ml daily intake for age 9-10 found by Galagan et al. (1957); but is greater than the 1,100 ml daily intake for teenagers reported by Hargreaves (1977). The mean beverage intake was assumed to reflect a minimum fluid intake because it did not include other fluids such as gelatin dessert, puddings, and popsicles. However, the number of children indicating consumption of gelatin dessert and pudding was virtually negligible for both seasons. The consumption of popsicles increased in the summer. These and other frozen or semi-frozen fluid sources not recorded in the DRINK DIARY may contribute sufficient fluid intake in summer to account for the unexpected decrease in the mean daily beverage intake from winter to summer. The difference, though noteworthy, was not significant.

Variation in Fluid Intake. The variability in daily intake by beverage category, especially for drinking water consumption, was greater than that reported by other authors. For those who reported any consumption of drinking water, the greatest range for any day was 0.25 to 13.00 units for boys, on Friday in the summer in Camrose. The range of 50 to 2,600 ml was a greater variation than found by McClure

(1943) at 812 to 1,166 ml per day and McPhail and Zacherl's (1965) 95 per cent probability of 359 to 662 mls per day for age 9-10. For all other categories comparable to McPhail and Zacherl (1965), there is more variation reported in this study. This considerable variation in all categories appears to be a reflection of the variety of beverages available and the freedom of selection. This is in agreement with Bonham et al. (1964) who suggested that, independent of the major physiological demand imposed by a hot climate, fluids ingested on the basis of individual preference show a wide quantitative range.

Atmospheric Temperature as a Variable in Fluid Intake. In this study, the findings on the effect of atmospheric temperature on fluid intake were contrary to Galagan et al. (1957) who reported that intake varied directly with temperature. The lack of significant differences between winter and summer intake for any beverage category or three-day total supports the McPhail and Zacherl (1965) findings that the effect of temperature on fluid intake is altered by the indoor heating of homes and schools in winter. In this study, the winter and summer atmospheric temperatures for Camrose and Wetaskiwin were all within 10°C of the 20-year normal temperatures assumed in the description of the study. The winter means in this study were within 1°C and the summer means were within 4°C of the McPhail and Zacherl (1965) temperatures. Whole juice, soup, and tea were the only categories of beverages affected in ranking by season. Tea consumption was less frequent than soup and whole juice in winter but predominated in summer because of the preference for iced tea as a cooling drink. Although there were slight increases or decreases in means from winter to summer

in most categories, none were significant.

Gender as a Variable in Fluid Intake. Both Galagan (1957) and McPhail and Zacherl (1965) reported no appreciable differences between females and males in their fluid intake relative to body weight. In this study, there were no significant differences in height and weight between the sexes in either winter or summer. There were, however, highly significant differences in some beverage intake in both seasons. In the winter, males had significantly greater three-day mean intake of water ($p = 0.0024$) and all beverages ($p = 0.0095$). In the summer, males had significantly greater three-day mean intake of water ($p = 0.0049$), milk ($p = 0.0000$) and all beverages ($p = 0.0003$).

Beverage Intake in Non-fluoridated and Fluoridated Communities

There were no significant differences in three-day mean intake of beverages between the non-fluoridated (Camrose) and fluoridated (Wetaskiwin) communities for either the winter or summer season. Tables 5 to 8 do show some differences by day. In Camrose, the greatest mean intake for carbonated beverages and daily totals were on Friday for both winter and summer. In Wetaskiwin, the greatest means were on Saturday in both winter and summer. Distinct patterns were not evident for other beverage categories. The ramifications of cultural and ethnic influences, socio-economic status, urbanization trends, and even shopping patterns, were not critical in this investigation.

Crucial to this study, however, is the assurance that the three-day means do represent beverages consumed in Camrose and Wetaskiwin by children resident in their respective communities. Only

four children in winter and 12 in summer indicated one day or part of a day away from home; this is only one per cent of all daily beverage records. Beverage consumption as shown in the results clearly represents consumption in Camrose and in Wetaskiwin.

Although there were no significant differences between the cities of Camrose and Wetaskiwin, within each community there were significant differences between females and males as shown in Tables 9-C and 9-D. For aggregated winter and summer intakes, Camrose males had significantly greater three-day mean intakes of water ($p = 0.0001$), milk ($p = 0.0053$) and all beverages ($p = 0.0000$) than females. For aggregated winter and summer intakes, Wetaskiwin males had a significantly greater three-day mean intake of milk ($p = 0.0031$) than females.

Range of Fluoride Intake from Beverages in Non-Fluoridated and Fluoridated Communities

The daily fluoride intakes from beverages in Camrose and Wetaskiwin as shown in Tables 11 and 12 vary in several respects from the intake for ten-year olds calculated by Myers (1978) and from the findings of McPhail and Zacherl (1965). This study reveals actual cases in which the difference in fluoride intake from beverages between Camrose (0.23 ppm fluoride) and Wetaskiwin (1.08 ppm fluoride) was less than expected relative to the fluoride concentration of the drinking water in those communities.

The fluoride intake profile calculated by Myers is based on drinking water concentration at 1 ppm fluoride. For age 9-10, Myers' calculation of total fluoride consumed was 1.006 mg per day. The range

of fluoride intake shown in Tables 11 and 12 for the fluoridated city (Wetaskiwin) in this study was 0.40 ppm to 2.45 ppm. The range in the non-fluoridated city (Camrose) was 0.02 ppm to 0.82 ppm. The variation indicated by these ranges was a result of choice of beverage as well as total quantity consumed.

The increase in consumption of soft drinks, reconstituted juices, and ades in this study relative to those of McPhail and Zacherl is evidence which supports the suggestion that the drinking of water is being replaced by the consumption of other beverages (Schultz, 1976; Singer and Ophaug, 1978). The major replacement, as shown in this study, is carbonated beverages. The high fluoride content of carbonated beverages bottled with fluoridated drinking water has been shown by Schultz (1976), Shannon (1977), and Hargreaves (1984). The daily fluoride intake of 0.82 ppm for student C, Non-fluoridated, Table 11, demonstrates the availability of fluoride from carbonated beverages. In this case, the carbonated beverage contribution of fluoride to the total of 0.82 ppm was 0.69 ppm. The strength of this evidence is upheld by the methodological considerations of this study: all carbonated beverages available in Camrose and Wetaskiwin were known to be distributed from Edmonton and would normally be prepared from Edmonton water containing 1 ppm fluoride. Only one per cent of daily beverage consumption was reported to have been consumed away from Camrose and Wetaskiwin. The ready access by children in Camrose, a non-fluoridated city, to a beverage source of fluoride other than drinking water, is indisputable.

The range of fluoride available through beverage consumption, as shown by the highest and lowest reported individual student intakes in

Tables 11 and 12, is a vital concern in the prescription of oral fluoride supplements and in the prevention of dental fluorosis. Of the lowest beverage intakes for a non-fluoridated city in Table 12, only two children would require full daily supplementation at 1.0 mg fluoride. Of the highest beverage intakes for a non-fluoridated city in Table 11, one child would require no supplementation, and the other two children would require intermediate supplementation. Without regard for the types and quantities of beverages consumed, fluoride supplementation on the basis of fluoride level in the drinking water is likely to result in an overestimation of the total fluoride requirement.

The effects of beverage choice and total beverage consumption in the fluoridated city are also of concern. Of the lowest beverage intakes in Table 12, two children would require additional supplementation in accordance with currently accepted dosage schedules. By contrast, student B in Table 11 showed an excessive daily fluoride intake which could result in mild to moderate fluorosis in developing permanent dentition (Melberg & Ripa, 1983).

Dental Health in Non-Fluoridated and Fluoridated Communities

Significance of Oral Health Indices. When all children were considered, regardless of length of residency in either community, there were no significant differences between Camrose and Wetaskiwin in oral health as defined by indices of gingivitis, oral hygiene and dental caries. Between females and males, the significant differences were the better oral hygiene ($p < 0.01$) and lower DMFT ($p < 0.05$) found in females.

In consideration of exposure to fluoridated water versus non-fluoridated water, a residence requirement was determined. All children with verifiable terms of residency in either community were appointed to one of two groups: those who had resided in the community for less than five years and those who had resided in the community for five or more years. The children in Wetaskiwin, age 12 during the study, would have had the benefit of fluoridated water for all of their permanent teeth if they had lived in that community for more than five years (Myers, 1978, page 41). Conversely, children in Camrose would certainly not have the benefit of fluoridated water if they had lived there for more than five years.

When only those children who had lived in either community for more than five years were considered, there were still no significant differences between Camrose and Wetaskiwin in caries indices, both DMFT and DMFS. This fact is particularly meaningful when the DMFT indices are compared with those of Castaldi et al. (1963). The Wetaskiwin DMFT has remained the same: 2.3 teeth in 1963, 2.26 teeth in 1984. Camrose, by comparison, has decreased dramatically from 6.1 teeth in 1963 to 2.43 in 1984. Although Castaldi's indices were for age 11 and these were for age 12, the difference in age does not contribute significantly to the differences in indices. Moreover, efforts were made to reflect a similar standard of diagnosis. Questionable early carious lesions noted in the 1984 examination were not included in the analysis of results in order to enhance their comparability with the 1963 results.

Plausible Causation. The results for Wetaskiwin are in keeping

with the overwhelming evidence in support of fluoridated water supplies (WHO Mono. 59, 1970; Myers, 1978; Murray & Rugg-Gunn, 1982). Within Wetaskiwin, there were significant differences between the less than five years residency and more than five years residency groups for both DMFT ($p < 0.04$) and DMFS ($p < 0.01$). These differences demonstrate the impact of term of residence in a fluoridated community (Myers, 1978; Murray & Rugg-Gunn, 1982). These differences are also a powerful affirmation of the need to consider residency in any investigation of caries experience.

The unquestionable decline in Camrose caries is not readily explained. Of the numerous factors which might be considered, the most relevant are exposure to fluoride, and change in diet. Long-term systemic fluoride exposure could be in the form of oral fluoride supplementation. Of the 77 children residing in Camrose for more than five years only 11 children may have had some exposure to fluoride supplements prescribed by Alberta East Central Health Unit in Camrose. Of the 11 children with prescriptions, only 5 ever requested a refill for either drops or tablets. Compliance with the supplementation regimen among the children of this group is certainly highly questionnable. Oral fluoride supplements do not appear, therefore, to have contributed to caries prevention among the children resident more than five years in Camrose.

Other forms of fluoride have been available to the children of Camrose and Wetaskiwin. The Local Health Authorities in both cities deliver preventive services such as prophylaxis and topical fluoride application, dental health education in schools, and promotion of

dental health. The impact of these services together with those of private practice dentists is not measureable.

The most readily available form of fluoride is in dentifrice. The benefits of regular and sustained use of a fluoridated dentrifice are well documented (Murray & Rugg-Gunn, 1982; Hargreaves et al. 1983; Melberg & Ripa, 1983). It has been suggested by Hargreaves et al. (1983) that the increased use of fluoride-containing dentrifices is responsible for the decrease in dental caries prevalence and improvement in oral hygiene in children of the Island of Lewis (Scotland) where no other forms of fluoride are available. Fluoride dentifrices have been shown to provide an additional anticaries benefit to that obtained from water fluoridation (Melberg & Ripa, 1983). This could, in part, explain the slight decrease in caries in Wetaskiwin children. Moreover, ingestion of fluoride is known to occur accidentally during tooth brushing. Melberg and Ripa (1983) suggest that children age two to four may ingest as much as 35 per cent of toothpaste used whereas adults are likely to ingest only three per cent. The combination of systemic and topical fluoride protection seems likely to be a major factor in the reduction of caries in Camrose children.

It must be recognized that topical fluoride application of any kind in fluoridated communities such as Wetaskiwin, where the dental caries activity is already low, will not produce the same percentage reduction as in a non-fluoridated community. A 30 to 40 per cent caries reduction in a non-fluoridated community may mean a reduction of one or more carious surfaces per person annually whereas the same

percentage reduction in a fluoridated community may mean a decrease in the annual caries increment of less than one-half a surface (Melberg & Ripa, 1983, page 196).

Need for Further Investigation

Notwithstanding the many definitive studies regarding the benefits of fluoridation, caries experience relative to fluid intake must be thoroughly scrutinized. As early as 1964, Gray et al. found only slight differences in the caries attack rates of children who had ingested high and low amounts of fluoride from fluid intake between birth and two years of age. More recent authors have referred to the changing patterns of fluid intake (Singer & Ophaug, 1978; Ericcson & Wei, 1979; Pao, 1981; Hargreaves, 1982). Even though actual dietary change for Camrose children has not been documented, this study demonstrates a beverage intake pattern in which carbonated beverages were the third most frequently consumed beverage after milk and water. The carbonated beverages available in Camrose are made with fluoridated water. Other potential beverage sources of fluoride are commercially prepared juices and ades which have been reconstituted with fluoridated water. Although carbonated beverages have not been demonstrated as a source of fluoride for younger age groups who would benefit most from ingestion, they must be considered as an additional source of fluoride which will contribute to caries prevention.

The precise benefits of each of the previously named sources of fluoride, systemic and topical, when cumulated in any order are not

understood and could be the subject of further research.

Realibility and Validity

In this study the methodological considerations of reliability and validity were addressed through the approach to the collection of both beverage intake and oral health data. Young and Trulson (1960) suggested that the usual eating pattern may need to be sacrified in order to obtain the greatest reliability in what is actually consumed. The educational method used in this study included carefully planned classroom instruction emphasizing accuracy in recording quality and quantity, and reward tokens reinforcing successful completion of the record. The interest and enthusiasm shown by the study groups were demonstrated in the detail included in the records and in the verification sessions following the recordings. Beal (1980, page 82) suggested that the accurate reporting of food intake is affected by a wide range of psychological and socio-economic differences. In this study, in addition to utilizing an educational approach to promote favourable results, these differences were minimized by the selection of children who were of the same age, lived in communities in close proximity, and shared very similar life styles. The three-day DRINK DIARY appears to have fulfilled successfully the guidelines established by Marr (1971) and Beal (1980).

The oral health data was provided by two dentist examiners with known interrater reliability. The four oral health indices which were used are nearly universally accepted as valid and reliable indicators

of the health of gingiva, the state of oral hygiene, and the status of dental caries and treatment for caries.

Conclusions

The results of this fluid intake study describe comprehensively the beverage intake of a population of children 12 years of age. The top four beverages ranked in order of daily means and frequency of consumption were milk, water, carbonated beverages, and other beverages prepared with tap water in the home. There were no significant differences in beverage intake between the winter and summer seasons. There were also no significant differences in beverage intake between the non-fluoridated and the fluoridated community. The range of fluoride intake from beverage consumption in both communities was considerable as a result of beverage selection as well as total quantity consumed. The oral health of the children in the fluoridated and non-fluoridated communities was compared; there were no significant differences in the caries indices DMFT and DMFS between the two communities. A substantial source of fluoride was shown to be available in the non-fluoridated community from beverages other than water, most notably from carbonated beverages which had been commercially prepared with fluoridated water.

Recommendations

The sequellae of this investigation indicate both direction for

future studies and the need for caution in current public health practice. The lack of significant difference in the caries prevalence of children in fluoridated and non-fluoridated communities may lead to highly controversial speculation. The low caries prevalance in the fluoridated community is clearly an endorsement of the practice of fluoridation. The low caries prevalence in the non-fluoridated community may be attributable to other sources of fluoride which are not currently acknowledged in public health practice.

Future Investigation

Future investigation should attempt to identify a beverage intake profile for younger children of age four to seven. The permanent teeth of these children could be affected by fluoride intake from beverages such as carbonated drinks prepared with fluoridated water. Additional investigation should be directed towards identifying a fluorosis index for children in comparable fluoridated and non-fluoridated communities in order to determine dental exposure to fluoride. Fluorosis in a non-fluoridated community with minimal oral fluoride supplementation is incontrovertible evidence of the availability of fluoride from other sources such as beverages and dentifrices.

Public Health Practice

In Alberta, oral fluoride supplements are prescribed primilarly by Dental Officers of Health in Local Health Authorities. Although a provincial dosage schedule is available, actual dosages are prescribed by individual dentists and may vary from the schedule. Current practice is an adoption of the schedule recommended by the American

Dental Association and the American Academy of Pediatrics. For children of three to 13 years consuming drinking water with 0.3 ppm fluoride or less, such as Camrose, 1 mg fluoride is recommended (Melberg & Ripa, 1983, page 132). In this study, however, actual daily intake of fluoride from beverages ingested by children in Camrose was shown to vary from 0.02 ppm to 0.82 ppm fluoride.

With the evidence of fluoride in beverages, and the availability of fluoride through dentrifices, rinses, and gels, the currently accepted supplementation schedule should be reduced by at least one-half until those children at risk of fluorosis can be identified and appropriate dosages prescribed. Those children who are at risk of caries must also be identified in order that appropriate preventive treatment may be applied. Even in community health programs, the need for determining individual profiles is becoming more evident. Broad programs applied without consideration of the individual may fail to meet the needs of an individual who is a high caries risk and may, in the case of supplementation, actually contribute to fluorosis in an individual who is ingesting fluoride from other sources.

Community health authorities might consider the following components in an individual profile: a thorough personal, medical, and dental history to identify previous and current exposure to fluorides; a record of current fluid intake to identify beverage sources of fluoride and their relative contributions to total fluoride intake; and a test to identify high caries risk; for example, the Streptococcus mutans test. In addition to age, the variable of weight might be considered in the diagnosis of level of risk for fluorosis.

Appropriate preventive regimens may then be prescribed on an individual basis within the established program guidelines of the Local Health Authority. The advantages of such a strategy are the definitive response to identified needs, and the optimal use of available resources.

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APPENDICES

APPENDIX A

Tables and Illustrations from Related Literature

Table A-1

Percentage distribution of ounces of each kind of fluid consumed,[1] Antioch and Brentwood, Calif.

Kind of fluid consumed	Antioch	Brentwood
All fluids	[2] 100.0	[3] 100.0
Drinking water	33.8	36.4
Water based beverages	9.6	11.2
Milk	47.9	39.9
Carbonated beverages	3.0	3.6
Other fluids	5.7	8.9

[1] During 1,539 child-days in Antioch and 681 in Brentwood.
[2] 61,810 ounces.
[3] 27,044 ounces.

From Galagan, D.J., Vermilion, J.R., Nevitt, G.A., Zachery, M.S., & Dart, R.E. (1957): Climate and fluid intake. Public Health Rep. 72, 487. Courtesy of the United States Printing Service.

Table A-2

Comparison, in ounces per day per child and as a percentage figure, of whole milk to reconstituted milk intake and of total milk to total fluid intake

Milk intake	Age					
	under 1	1 - 2	3 - 4	5 - 6	7 - 8	9 - 10
Whole milk	18.55	11.83	12.53	11.05	11.29	12.27
Reconstituted milk	3.94	2.69	3.80	5.76	6.48	5.57
Total milk	22.49	14.52	16.33	16.81	17.77	17.84
% whole milk of milk total	82.48	81.47	76.73	65.73	63.53	68.78
% total milk of total fluid	68.13	59.92	56.16	53.91	49.90	40.64

From McPhail, C.W.B. & Zacherl, W. (1965): Fluid intake and climatic temperature. Relation to fluoridation. Can. Dent. Assoc. J. 31, 14. Reprinted by permission of the Canadian Dental Association and W. Zacherl.

Table A-3

Percentage distribution of all fluids consumed: Edmonton and Antioch-Brentwood studies

Fluid		Edmonton	Antioch-Brentwood[1]
Tap water			
(a) as such (Cat. 1 a & b)	22.7		
(b) in reconstituted milk (Cat. 10)	14.3	50.3	45.5
(c) other tap water based fluids (Cat. 2, 3, 4, 5 & 6)	13.3		
Whole (fluid) milk (Cat. 9 a & b)		40.9	43.9
Bottled carbonated drinks (Cat. 7)		2.0	3.3
Miscellaneous (whole juices, etc.) (Cat. 8 & 11)		6.8	7.3
Total		100.0	100.0

From McPhail, C.W.B. & Zacherl, W. (1965): Fluid intake and climatic temperature. Relation to fluoridation. Can. Dent. Assoc. J. 31, 15. Reprinted by permission of the Canadian Dental Association and W. Zacherl.

Table A-4a

Distribution of total fluid intake for all participants for the whole recording period, by age groups, in ounces per day per child

Age	Tap water consumed															
	1 Tap water drunk		2 Tap water added to baby formula	3 Juices made with tap water	4 Soup made with tap water	5 Tea	6 Other tap water beverages, coffee, etc.	7 Bottled carbonated drinks	8 Whole juices	9 Whole milk		10 Reconstituted milk		11 Misc.	12 Total
	(a) Home	(b) Other								(a) as such	(b) in foods	(a) as such	(b) in foods		
Under 1	1.13	0.03	4.86	0.67	0.04		0.16		2.12	17.31	1.24	3.71	0.23	0.61	32.11
S.E.	0.50	0.02	1.34	0.34	0.04		0.12		0.55	0.82	0.48	1.70	0.15	0.53	
1 - 2	3.72	0.10		1.09	0.74	0.10	0.79	0.42	1.97	10.67	1.16	2.46	0.23	0.78	24.23
S.E.	0.60	0.06		0.31	0.22	0.10	0.28	0.18	0.47	1.57	0.30	0.84	0.12	0.35	
3 - 4	6.29	0.26		1.84	0.96	0.23	1.04	0.53	1.36	11.03	1.50	3.34	0.46	0.24	29.08
S.E.	0.92	0.11		0.48	0.19	0.23	0.49	0.14	0.34	1.23	0.48	1.15	0.16	0.10	
5 - 6	6.71	1.25		2.00	1.07	0.47	0.40	0.43	1.60	10.08	0.97	5.32	0.44	0.43	31.18
S.E.	0.81	0.30		0.43	0.16	0.23	0.21	0.15	0.38	1.17	0.21	1.37	0.14	0.15	
7 - 8	8.16	2.29		1.95	1.37	0.26	0.55	1.60	1.25	10.41	0.88	5.68	0.81	0.41	35.61
S.E.	0.79	0.53		0.44	0.26	0.21	0.21	0.30	0.22	1.25	0.25	1.43	0.25	0.18	
9 - 10	12.74	4.27		2.47	1.89	0.25	0.89	1.24	1.71	11.38	0.89	4.39	1.18	0.37	43.67
S.E.	1.67	0.86		0.66	0.33	0.15	0.33	0.47	0.38	1.51	0.25	1.52	0.45	0.12	

From McPhail, C.W.B. & Zacherl, W. (1965): Fluid intake and climatic temperature. Relation to fluoridation. Can. Dent. Assoc. J. 31, 10. Reprinted by permission of the Canadian Dental Association and W. Zacherl.

Table A-4b

McPhail and Zacherl results converted to milliliters per person per day supplemented with estimates of fluoride provided by each category

Age, years	Drinking H_2O	Infant formula	Reconstituted juice	Soup	Tea	Other	Carbonated beverage	Whole juie	Milk	Reconstituted juice	miscellaneous	Total, ml
a Water consumption (in ml) per person per day, by age [McPhail and Zacherl 1965]												
0.5–1	35	146	20	1	–	5	–	64	557	118	18	964
1–2	115		33	22	3	24	13	59	355	81	23	728
3–4	197		55	29	7	31	16	41	376	114	7	873
5–6	238		60	32	14	12	13	48	332	173	13	935
7–8	314		59	41	8	17	48	38	339	193	12	1,069
9–10	510		74	57	8	27	37	51	368	167	11	1,310
b Fluoride consumed (in mg) in each of 11 categories of fluid consumption per person per day, by age												
0.5–1.0	0.035	0.102	0.02	0.00	–	0.005	–	0.079	0.111	0.142	0.018	0.452
1–2	0.115		0.03	0.02	0.003	0.02	0.001	0.018	0.071	0.097	0.023	0.578
3–4	0.197		0.06	0.03	0.008	0.03	0.001	0.012	0.075	0.137	0.007	0.557
5–6	0.238		0.06	0.03	0.017	0.01	0.001	0.014	0·066	0.208	0.013	0.657
7–8	0.314		0.06	0.04	0.01	0.02	0.034	0.011	0.068	0.232	0.012	0.801
9–10	0.510		0.07	0.06	0.01	0.03	0.026	0.015	0.074	0.200	0.011	1.006

From Myers, H.M. (ed.) (1977): Fluorides and dental fluorosis. In Monographs in Oral Science, vol. 7, p. 8. Basel, Switz: S. Karger. Reprinted by permission of S. Karger.

Table A-5

Fluoride content of soft drinks and beverages

		(ppm ± SD)	
Description	*F^- in Water*	*F in Product (number products)*	*Location*
SOFT DRINKS (24)			
A. Plant #1	1.47 ± 0.154	1.31 ± 0.125(37)	Houston, Tx.
Plant #2	0.59	0.54 ± 0.095(5)	Houston, Tx.
Plant #3	0.04	0.05 ± 0.005(6)	Houston, Tx.
Plant #4	0.07	0.05 ± 0.008(4)	Houston, Tx.
B. Cans (25)	1.1	0.89 ± 0.224(24)	Baltimore, Md.
Bottles	1.1	0.88 ± 0.117(39)	
MARKET BASKET (11)			
C. Beverages	1.0	1.35	San Francisco, Ca.
	0.9	0.82	Buffalo, N.Y.
	0.8	1.54	Atlanta, Ga.
	0.5	0.83	Kansas City, Mo.
D. Teas(26)	0	0.93 ± 0.601(24)* (0.11-3.4)**	Sweden
		0.85 ± 0.229(22)* (0.36-1.35)**	Sweden

*number of different brands of tea and the ranges found. **

From Singer, L. & Ophaug, R.H. (1979): Fluoride content of foods and beverages. In National symposium on dental nutrition, ed. S.H.Y. Wei, p. 61. Iowa: The University of Iowa. Reprinted by permission of L. Singer.

Table A-6

Fluoride assessment of beverages in non-fluoridated and fluoridated communities based on unpublished data from the laboratory of Dr. J.A. Hargreaves

	Camrose (non-fluoridated)	Wetaskiwin (fluoridated)
Drinking Water	0.23 ppm	1.08 ppm
Milk*	0.03 ppm	0.03 ppm
Juice (commercially prepared))	0.8 ppm	0.8 ppm
Juice (home reconstituted))	0.21 ppm	1.06 ppm
Carbonated Beverages	0.8 ppm	0.8 ppm
Soup	0.21 ppm	1.06 ppm
Tea	1.33 ppm	2.18 ppm
Coffee	0.23 ppm	1.08 ppm
Other	0.23 ppm	1.08 ppm
Miscellaneous**	0.1 ppm	0.1 ppm

* Available fluoride
** Miscellaneous normally manufactured with less than 0.1 ppm F.

NOTE: Carbonated beverages and juices are distributed to both communities through Edmonton manufacturers and suppliers.

Table A-7

A comparison of selected characteristics of diet methodologies

CHARACTERISTICS	DIET METHODOLOGY		
	FOOD RECORD	FOOD RECALL	FOOD FREQUENCY
Format	•form completed by client •open-ended questions	•interview (sometimes questionnaire •open-ended questions (sometimes closed questions)	•questionnaire (sometimes interview) •closed-ended questions
Type of Information	•foods eaten •amounts eaten often: time place commensality etc.	•foods eaten •amounts eaten often: time place commensality etc.	•foods eaten •frequency foods are chosen
Standard	C.D.S. C.F.G.	C.F.G. (with caution: C.D.S.)	none
Sample	•individuals or small groups	•large groups (not individuals)	•large groups or individuals
Time Span	3-7 days	24 hours	up to 12 months
Limiting Requirements	•client motivation, repeat visits	•memory (often availability of personnel)	•minimal
Most Common Uses	•research, •teaching	•surveys, •teaching, •programming	•programming

(The diet history technique is halfway between a food recall and a food frequency; it requires an extensive interview.)

Note: C.D.S. refers to the Dietary Standard for Canada
C.F.G. refers to Canada's Food Guide

From Campbell, C., Craig, P.M. & Rolf, C.A. (1980): A nutrition needs assessment of Edmonton adolescents, Volume one The methodology, p. 6. Report. Edmonton: Edmonton Local Board of Health. Reprinted by permission of the Edmonton Local Board of Health.

APPENDIX B

Consent Letters

B-1: First Consent, Camrose

FACULTY OF DENTISTRY
GRADUATE STUDIES AND RESEARCH

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA
T6G 2N8

December 1, 1983

Dear Parent:

Students in grades two and six in the City of Camrose are invited to participate in an important study that will be conducted by the Faculty of Dentistry, The University of Alberta. The study will determine the kinds and amounts of beverages which are currently consumed by elementary school children and how these beverages may affect their health, particularly their teeth.

The children who participate in this study will require very little instruction and time to complete the "drink diary". Their school work and classroom time will have minimal interruption, about 15 minutes per class before completing the diary, 5 minutes per child after completing the diary, and 5 minutes per child for the dental examination.

All participants will be instructed in the study procedures. Each child will be shown how to keep a beverage diary for three days both in January and again in May. All children will also have a visual dental examination to check their current dental health.

The results of this study will benefit your child and others if, as we hope, we are able to determine how different drinks and drinking habits affect their health.

We hope you agree to let your child participate in this important study and sign the consent below.

If you wish further information please contact either of the investigators:

Dr. J.A. Hargreaves
Graduate Studies & Research
Faculty of Dentistry
Dentistry/Pharmacy Building
The University of Alberta
Telephone: 432-4489

Ms. Joanne Clovis
Graduate Studies & Research
Faculty of Dentistry
Dentistry/Pharmacy Building
The University of Alberta
Telephone: 432-4489

I AGREE THAT MY CHILD WILL PARTICIPATE IN THE DRINK AND BEVERAGE STUDY.

CHILD'S NAME: _____

TELEPHONE NO.: _____

_____
Signature: Parent/Guardian

B-1: First Consent, Wetaskiwin

FACULTY OF DENTISTRY
GRADUATE STUDIES AND RESEARCH

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA
T6G 2N8

December 1, 1983

Dear Parent:

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Ms. Joanne Clovis
Graduate Studies & Research
Faculty of Dentistry
Dentistry/Pharmacy Building
The University of Alberta
Telephone: 432-4489

I AGREE THAT MY CHILD WILL PARTICIPATE IN THE DRINK AND BEVERAGE STUDY.

CHILD'S NAME: _____

TELEPHONE NO.: _____

_____
Signature: Parent/Guardian

B-2: Second Consent, Camrose

FACULTY OF DENTISTRY
GRADUATE STUDIES AND RESEARCH
January, 1984

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA
T6G 2N8

Dear Parent:

Students in grades two and six in the City of Camrose are invited to participate in an important study that will be conducted by the Faculty of Dentistry, The University of Alberta. The study will determine the kinds and amounts of beverages which are currently consumed by elementary school children and how these beverages may affect their health, particularly their teeth.

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The results of this study will benefit your child and others if, as we hope, we are able to determine how different drinks and drinking habits affect their health.

We hope you agree to let your child participate in this important study and sign the consent below. Please return this consent form to your child's classroom teacher by Friday, January 13, 1984.

If you wish further information please contact either of the investigators:

Dr. J.A. Hargreaves
Graduate Studies & Research
Faculty of Dentistry
Dentistry/Pharmacy Building
The University of Alberta
Telephone: 432-4489

Ms. Joanne Clovis
Graduate Studies & Research
Faculty of Dentistry
Dentistry/Pharmacy Building
The University of Alberta
Telephone: 432-4489

I AGREE THAT MY CHILD WILL PARTICIPATE IN THE DRINK AND BEVERAGE STUDY.

CHILD'S NAME: _____

TELEPHONE NO.: _____

TOTAL NUMBER OF YEARS WE HAVE LIVED IN CAMROSE: _____

_____
Signature: Parent/Guardian

PLEASE RETURN THIS CONSENT TO YOUR CHILD'S CLASSROOM TEACHER.

B-2: Second Consent, Wetaskiwin

FACULTY OF DENTISTRY
GRADUATE STUDIES AND RESEARCH
January, 1984

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA
T6G 2N8

Dear Parent:

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I AGREE THAT MY CHILD WILL PARTICIPATE IN THE DRINK AND BEVERAGE STUDY.

CHILD'S NAME: _____

TELEPHONE NO.: _____

TOTAL NUMBER OF YEARS WE HAVE LIVED IN WETASKIWIN: _____

_____
Signature: Parent/Guardian

PLEASE RETURN THIS CONSENT TO YOUR CHILD'S CLASSROOM TEACHER.

B-3: Third Consent, Camrose

FACULTY OF DENTISTRY
GRADUATE STUDIES AND RESEARCH

February, 1984

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA
T6G 2N8

Dear Parent:

Students in grades two and six in the City of Camrose are invited to participate in an important study that will be conducted by the Faculty of Dentistry, The University of Alberta. The study will determine the kinds and amounts of beverages which are currently consumed by elementary school children and how these beverages may affect their health, particularly their teeth.

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We hope you agree to let your child participate in this important study and sign the consent below. Please return this consent form to your child's classroom teacher.

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Ms. Joanne Clovis
Graduate Studies & Research
Faculty of Dentistry
Dentistry/Pharmacy Building
The University of Alberta
Telephone: 432-4489

I AGREE THAT MY CHILD WILL PARTICIPATE IN THE DRINK AND BEVERAGE STUDY.

CHILD'S NAME: _____

TELEPHONE NO.: _____

TOTAL NUMBER OF YEARS WE HAVE LIVED IN CAMROSE: _____

_____
Signature: Parent/Guardian

PLEASE RETURN THIS CONSENT TO YOUR CHILD'S CLASSROOM TEACHER.

B-3: Third Consent, Wetaskiwin

FACULTY OF DENTISTRY
GRADUATE STUDIES AND RESEARCH
February, 1984

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA
T6G 2N8

Dear Parent:

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I AGREE THAT MY CHILD WILL PARTICIPATE IN THE DRINK AND BEVERAGE STUDY.

CHILD'S NAME: _____

TELEPHONE NO.: _____

TOTAL NUMBER OF YEARS WE HAVE LIVED IN WETASKIWIN: _____

_____
Signature: Parent/Guardian

PLEASE RETURN THIS CONSENT TO YOUR CHILD'S CLASSROOM TEACHER.

APPENDIX C

Definitions of Beverage Categories

Beverage Category Definitions

CARB. BEV.	is any carbonated beverage of any flavour or sweetening agent and sold by the bottle or can or as a fountain drink.
COFFEE	is any instant or percolated coffee drink prepared by adding tap water.
MILK	is whole or partly skimmed milk, fresh or reconstituted; milk shakes are equivalent to milk.
MISC.	is any miscellaneous drink prepared commercially or in the home which can not be defined by any other category.
OTHER	is other tap water added to syrups or powdered mixes to prepare ades or punches in the home.
RECONST. J.(C.)	are reconstituted fruit or vegetable juices commercially prepared and sold in single or multiple serving cartons and bottles. (Some beverages in this category may, in fact, be ades or punches).
RECONST. J.(H.)	are reconstituted fruit or vegetable juices prepared in the home by adding tap water to frozen or canned concentrates.
SOUP	is any commercial or home soup preparation to which tap water has been added.
TEA	is any regular, special flavour, herbal or iced tea drink prepared by adding tap water.
WATER	is tap water taken as such.
WHOLE JUICE	is whole fruit or vegetable juice sold by the can or bottle.

APPENDIX D

Drink Diary

DRINK DIARY

THIS IS THE PERSONAL DRINK DIARY OF:

_____

MY BIRTHDATE IS:

_____

I LIVE IN THE CITY OF:

_____

I AM _____ CENTIMETERS TALL.

I WEIGH _____ KILOGRAMS.

FACULTY OF DENTISTRY
GRADUATE STUDIES AND RESEARCH

THE UNVERSITY OF ALBERTA
EDMONTON, CANADA
T6G 2N8

January, 1984

Dear Participant:

Your beverage diary will take very little time to complete if you follow these guidelines. You may need some help from your parents. Please let them read this letter and look at your Drink Diary:

You may use your container when you are drinking or you may drink from another container. **Just remember that your container should not be washed in a dishwasher.** Please record your drinks in this way:

1. **Using the container:**
   This is the guide to use if you drink from the container.

Container filled to the line.....1

Container ¾ filled.....¾

Container ½ filled.....½

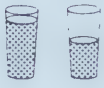
Container ¼ filled.....¼

If you have more than one container full of beverage, you can add amounts to 1.

EXAMPLE: Container filled to the line..... 1

+ Container ½ filled..... ½

Total..... 1½



2. Estimating drinks you cannot measure:

If you drink from other containers you can use this guide.

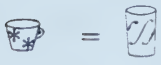
1 small can of soda pop	=	1½
1 small bottle of soda pop	=	1½
1 large glass	=	1½
1 mug or large cup	=	1½

= 1½

1 small carton	=	1¼

= 1¼

1 normal cup	=	1
1 small drink in a take-out cup	=	1

 = 1

You may want to carry this diary and container with you to school on Thursday and Friday or somewhere else on Saturday.

We're really excited about seeing your personal Drink Diary!

Sincerely,

Joanne Clovis, Dip.D.H., B.Ed.
University of Alberta,
Faculty of Dentistry

JC/md
P.S.: **PLEASE REMEMBER TO BRING YOUR DIARY BACK ON MONDAY!**

These are all the drinks I have had. (including milk with cereal and water in soup)	This is how much I drank each time. 1 ¾ ½ ¼	This is my brand.	This is the flavour I had.	This is for the dental hygenist. I'll leave it BLANK!

WEDNESDAY

	ITEM	UNITS	BRAND	FLAVOUR	
Breakfast	juice	1/2	Old South (frozen)	orange	
	milk	3/4	Carnation powdered	white	
Mid-morning	water	1/2	fountain		
Lunch	lemonade	1	Empress crystals	lemon	
	water in soup	1/2	Lipton	chicken noodle	
Mid-afternoon	orange drink	1 1/4	Dairy-Maid (carton)	orange	
Supper	tea with milk	1/2	Lipton's tea 2% lucerne (carton)	orange pekoe white	
Evening	water	1 1/4			
	soda pop	1/4	Pop Shoppe (bottle)	grape	

SAMPLE

THURSDAY

	ITEM	UNITS	BRAND	FLAVOUR	
Breakfast					
Mid-morning					
Lunch					
Mid-afternoon					
Supper					
Evening					

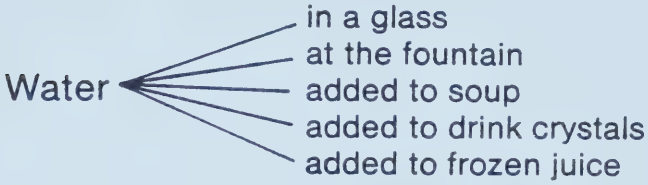
FRIDAY

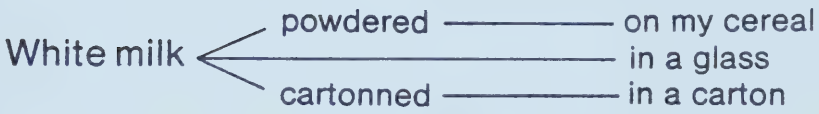
	ITEM	UNITS	BRAND	FLAVOUR	
Breakfast					
Mid-morning					
Lunch					
Mid-afternoon					
Supper					
Evening					

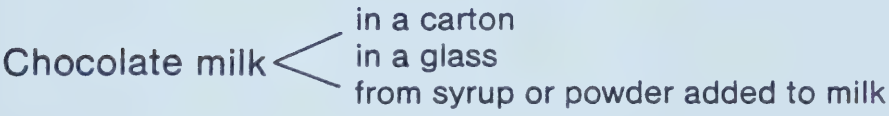
SATURDAY

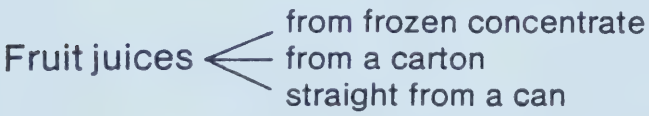
	ITEM	UNITS	BRAND	FLAVOUR	
Breakfast					
Mid-morning					
Lunch					
Mid-afternoon					
Supper					
Evening					

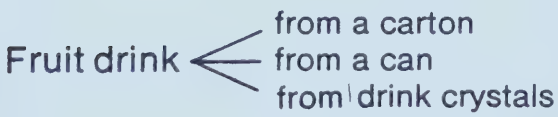
These are some of the DRINKS I might have:

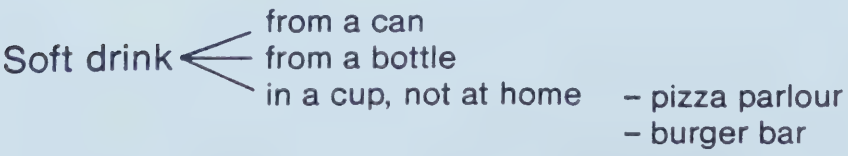












APPENDIX E

Pretest Results

Table E-1

Results of grade six pretest - Physical attributes of students

Variable	n	Mean ± sd	Minimum	Maximum
age*	15	11.53 ± 0.34	10.92	12.17
height**	15	58.3 ± 2.2	55.5	63.5
weight***	15	84.5 ± 13.5	59.5	105.0

* age = age in years
** height = height in inches
*** weight = weight in pounds

Table E-2

Results of grade six pretest - Mean beverage intake in units by day ranked by frequency of consumption of intake for three days

Beverage Category	Mean consumption by day** Thursday Mean ± sd	n	Friday Mean ± sd	n	Saturday Mean ± sd	n	Intake for Three Days Mean ± sd	n
Milk	1.79±1.58	12	1.63±1.50	12	1.84±2.01	11	4.37±4.48	14
Water	1.58±0.97	10	1.98±1.88	12	1.73±0.99	13	4.36±3.48	14
Other*	2.43±1.13	7	1.36±0.58	7	2.88±2.41	6	4.38±3.66	10
Carb. bev.*	1.60±0.82	5	2.42±1.26	9	1.61±0.68	7	3.73±1.49	11
Reconst. j. (h)*	1.25±1.06	2	1.06±0.43	4	1.25±0.84	4	2.35±2.10	5
Whole juice	1.75±1.06	2	2.50±2.12	2			4.25±3.18	2
Coffee	1.50	1	1.50	1	1.50	1	4.50	1
Tea	0.63±0.53	2	0.75±0.25	3	0.75	1	1.06±0.32	4
Soup	0.50	1	0.50	1	0.50	1	0.75±0.35	2
Reconst. j. (c)*	1.00	1					1.00	1
Total	4.76±1.94	15	5.87±2.28	15	5.26±2.07	15	15.90±5.24	15

** consumption in units, 1 unit = 200 ml

* abbreviations:
Other = other tap water added to prepare ades or punches
Carb. bev. = carbonated beverages
Reconst. j. (h) = reconstituted juice, home prepared
Reconst. j. (c) = reconstituted juice, commercially prepared

APPENDIX F

Results of the Survey of Beverage Retailers Supplying the Study Groups

F-1: Beverage sources for the study groups

Retailer	SOURCE OF SUPPLY FOR BEVERAGES		
	Milk	Carbonated Beverages	Juices
CAMROSE			
1. Co-op	only NADP* local	Grey,Can.Dry, Coca-Cola from Edmonton	Federated Co-op, Edmonton
2. Red Rooster	only NADP local	Grey,Can.Dry, Coca-Cola from Edmonton	Edmonton
3. Tom Boy	only NADP local	Grey,Can.Dry, Coca-Cola from Edmonton	Western Grocers, Edmonton
4. Safeway	only NADP local		Safeway, Edmonton
5. Eddie's Q-Mart Foods	only NADP local	Grey,Can.Dry, Coca-Cola from Edmonton	Alberta Grocers, Edmonton
6. Alberta Grocers Cash & Carry (for Business only)	All products from Alberta Grocers, Edmonton		
7. IGA	only NADP local	Grey,Can.Dry, Coca-Cola from Edmonton	Horne & Pitfield, Edmonton
8. McDonald's	only NADP local	syrup & water-fountain	Martin Brower, Vancouver

* NADP = Northern Alberta Diary Pool

F-1: Beverage sources for the study groups (continued)

Retailer	SOURCE OF SUPPLY FOR BEVERAGES		
	Milk	Carbonated Beverages	Juices
WETASKIWIN			
1. A. & W.	NADP* local & Edmonton Palm	syrup & water-fountain bottles/ cans from Edmonton	Edmonton
2. Grandma Lee's	NADP local & Edmonton Palm	syrup & water-fountain	Edmonton
3. Tom Boy	NADP local & Edmonton Palm	bottles/cans from Edmonton	Edmonton
4. IGA	NADP local & Edmonton Palm	direct delivery from Edmonton	Horne & Pitfield, Edmonton
5. Co-op	NADP local & Edmonton Palm	Grey & Coca-Cola	Federated Co-op, Edmonton
6. Red Rooster	NADP local & Edmonton Palm	All Edmonton	Edmonton
7. Safeway	NADP local & Edmonton Palm	Grey, etc. Edmonton	Safeway, Edmonton
8. McDonald's	Palm	syrup & water-fountain	Grapefruit-HP.Hood Orange-Mississauga Tomato-Heinz
9. Kentucky Fried Chicken	NADP local & Edmonton	canned from Edmonton syrup & water-fountain	None

* NADP = Northern Alberta Dairy Pool

APPENDIX G

Estimation of Water Fountain Consumption

Table G-1

Number of swallows required to consume 100 ml of water recorded by students in grade six

Trial 1 No. of swallows	n	Trial 2 No. of swallows	n	Trial 3 No. of swallows	n
2	1	2	4	2	7
3	2	3	3	3	3
4	3	4	3	4	3
5	3	5	2	5	1
6	4	6	3	6	3
7	2	7	3	7	0
8	4	8	1	8	1
9	1	9	2	9	0
10	1	10	2	10	3
11	0	11	1	11	3
12	2			12	1
13	1				
20	1	25	1		
Total 181	25	160	25	141	25
Mean 7.2		6.4		5.6	
sd 3.9		4.8		3.6	

Table G-2

Number of milliliters of water expectorated in 3 and 5 gulps of water from the fountain

	3 gulps (N=12)	5 gulps (N=12)
	30	45
	33	62
	40	72
	50	73
	83	85
	85	85
	113	90
	120	105
	120	115
	130	140
	130	142
	165	172
Total	1,123	1,336
Mean	94.1	106.2
SD	47.3	47.7

3 gulps = 94.1 ml
1 gulp = 31.4 ml

5 gulps = 106.2 ml
1 gulp = 21.3 ml

APPENDIX H

Dental Examination Record

DENTAL CHART IV

INDIVIDUAL SUBJECT RECORD

URL I

ALL CARDS

TRIAL NUMBER		1	2	3
SUBJECT NUMBER	4	5	6	7
EXAMINATION				8

(NOTE. BASELINE – 1. 1st EXAM – 2. 2nd. EXAM – 3. 3rd. EXAM – 4)

(CARD 1)

MASTER CARD

EXAMINATION TYPE (9)

(CLINICAL–1, RADIOGRAPHIC–4)

EXAMINER (CODE) (10)

AGENT (CURRENT) (11) (12)

SCHOOL (CODE) (13) (14)

DATE EXAMINATION (DAY, MONTH, YEAR) 15 16 17 18 19 20

NAME (ALPHABETIC)

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	

ADDRESS NOT PUNCHED

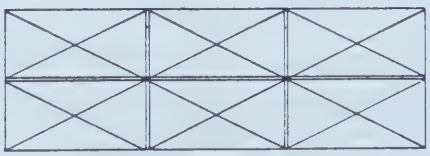
SEX (FEMALE–1, MALE–2) (54)

DATE OF BIRTH (MONTH, YEAR) 55 56 57 58

RACE (61) (62)

OCCUPATION (PARENT) (CODE) 63 64 65

GINGIVITIS



TOTAL =

TOTAL /24 = 67 68

ORAL HYGIENE

TOTAL = TOTAL /6 = 69 70

JAW CARDS

EXAMINATION TYPE 9

DENTITION TYPE 10

(CARD 2) UPPER (CLINICAL-2 RADIOGRAPH-5)

(CARD 3) LOWER (CLINICAL-2 RADIOGRAPH-6)

					P PERMANENT		D DECIDUOUS			P PERMANENT		D DECIDUOUS		
RIGHT	7	SECOND MOLAR	OCCLUSAL	17	O					O				
			BUCCAL	18	B					B				
			MESIAL	19	M					M				
			LINGUAL	20	L					L				
			DISTAL	21	D					D				
	6	FIRST MOLAR	OCCLUSAL	22	O					O				
			BUCCAL	23	B					B				
			MESIAL	24	M					M				
			LINGUAL	25	L					L				
			DISTAL	26	D					D				
	5	SECOND BICUSPID	OCCLUSAL	27	O					O				
			BUCCAL	28	B					B				
			MESIAL	29	M					M				
			LINGUAL	30	L					L				
		E	DISTAL	31	D					D				
	4	FIRST BICUSPID	OCCLUSAL	32	O					O				
			BUCCAL	33	B					B				
			MESIAL	34	M					M				
			LINGUAL	35	L					L				
		D	DISTAL	36	D					D				
	3	CANINE	BUCCAL	37	B					B				
			MESIAL	38	M					M				
			LINGUAL	39	L					L				
		C	DISTAL	40	D					D				
	2	LATERAL	BUCCAL	41	B					B				
			MESIAL	42	M					M				
			LINGUAL	43	L					L				
		B	DISTAL	44	D					D				
	1	CENTRAL	BUCCAL	45	B					B				
			MESIAL	46	M					M				
			LINGUAL	47	L					L				
		A	DISTAL	48	D					D				
LEFT	1	CENTRAL	BUCCAL	49	B					B				
			MESIAL	50	M					M				
			LINGUAL	51	L					L				
		A	DISTAL	52	D					D				
	2	LATERAL	BUCCAL	53	B					B				
			MESIAL	54	M					M				
			LINGUAL	55	L					L				
		B	DISTAL	56	D					D				
	3	CANINE	BUCCAL	57	B					B				
			MESIAL	58	M					M				
			LINGUAL	59	L					L				
		C	DISTAL	60	D					D				
	4	FIRST BICUSPID	OCCLUSAL	61	O					O				
			BUCCAL	62	B					B				
			MESIAL	63	M					M				
			LINGUAL	64	L					L				
		D	DISTAL	65	D					D				
	5	SECOND BICUSPID	OCCLUSAL	66	O					O				
			BUCCAL	67	B					B				
			MESIAL	68	M					M				
			LINGUAL	69	L					L				
		E	DISTAL	70	D					D				
	6	FIRST MOLAR	OCCLUSAL	71	O					O				
			BUCCAL	72	B					B				
			MESIAL	73	M					M				
			LINGUAL	74	L					L				
			DISTAL	75	D					D				
	7	SECOND MOLAR	OCCLUSAL	76	O					O				
			BUCCAL	77	B					B				
			MESIAL	78	M					M				
			LINGUAL	79	L					L				
			DISTAL	80	D					D				

APPENDIX I

Beverage Intake by Gender

Table I-1-A

Camrose winter beverage intake for females and males on Thursday

Beverage Category	Mean consumption in units** Female (N=61) Mean ± sd	Range	n	Male (N=58) Mean ± sd	Range	n
Milk	2.20±1.24	0.50- 6.00	55	2.55±1.68	0.50- 8.50	50
Water	1.62±1.43	0.25- 6.75	47	3.11±2.45	0.25-10.75	48
Carb. bev.*	1.28±0.77	0.25- 3.50	15	1.30±0.67	0.25- 3.00	16
Other*	1.79±1.28	0.50- 5.25	21	1.84±0.91	0.50- 4.00	23
Reconst. j. (h)*	1.59±0.82	0.50- 3.00	16	2.44±1.73	0.75- 5.50	16
Reconst. j. (c)*	2.15±2.68	0.75-10.75	13	1.31±0.13	1.25- 1.50	4
Whole juice	1.29±0.62	0.50- 2.25	6	0.79±0.43	0.25- 1.50	6
Tea	1.69±0.55	0.10- 2.25	4	1.00		1
Soup	1.13±0.38	0.75- 2.00	8	1.00±0.50	0.25- 2.25	12
Misc.*	0.50±0.35	0.25- 0.75	2	1.00		1
Coffee	1.00		1			
Daily total	5.46±2.09	2.50-14.00	61	6.96±2.74	2.50-13.75	58

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-1-B

Camrose winter beverage intake for females and males on Friday

Beverage Category	Mean consumption in units** Female (N=61) Mean ± sd	Range	n	Male (N=58) Mean ± sd	Range	n
Milk	3.00±1.29	0.25- 7.00	55	2.67±1.65	0.20- 7.00	49
Water	1.74±2.01	0.25-12.00	45	2.69±2.03	0.25- 7.50	45
Carb. bev.*	2.18±1.56	0.50- 7.00	26	2.02±1.10	0.50- 4.00	23
Other*	1.71±1.04	0.50- 4.00	18	2.33±1.16	0.75- 4.50	16
Reconst. j. (h)*	1.20±0.83	0.25- 3.00	15	1.79±1.01	0.50- 4.25	19
Reconst. j. (c)*	1.61±0.56	1.00- 2.50	14	1.53±0.79	0.75- 3.00	9
Whole juice	1.59±1.22	0.25- 4.00	8	1.15±0.34	0.75- 1.50	5
Tea				1.00		1
Soup	1.04±0.37	0.50- 1.50	6	1.29±0.88	0.75- 3.00	6
Misc.*	2.00		1			
Coffee	1.00		1	1.00		1
Daily total	5.66±2.57	1.25-16.25	61	6.88±3.05	1.00-17.75	58

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-1-C

Camrose winter beverage intake for females and males on Saturday

Beverage Category	Mean consumption in units** Female (N=61) Mean ± sd	Range	n	Male (N=58) Mean ± sd	Range	n
Milk	2.52±1.77	0.25- 9.00	52	2.50±1.80	0.50- 9.50	45
Water	2.09±1.84	0.25- 9.00	31	2.32±2.21	0.25-11.75	42
Carb. bev.*	2.13±1.57	0.25- 6.00	29	1.96±1.07	0.75- 4.50	26
Other*	2.09±2.25	0.25-11.00	24	2.35±1.54	0.50- 5.00	23
Reconst. j. (h)*	1.39±1.29	0.25- 4.25	14	1.45±1.01	0.50- 3.75	15
Reconst. j. (c)*	2.08±1.44	1.25- 3.75	3	1.36±0.69	0.25- 2.50	7
Whole juice	1.39±0.91	0.50- 3.00	7	3.00±1.00	2.00- 4.00	3
Tea	1.38±0.75	0.50- 2.00	4	2.00±1.00	1.00 - 3.00	3
Soup	1.59±0.93	0.75- 3.00	8	1.46±1.34	0.75- 4.00	7
Misc.*	2.10±1.39	0.50- 3.50	5	1.25±0.35	1.00- 1.50	2
Coffee				0.25		1
Daily total	6.11±3.12	0.50-19.00	61	6.38±2.90	1.50-13.25	58

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-1-D

Total Camrose winter beverage intake for females and males for three days

Beverage Category	Mean consumption in units** Female (N=61) Mean ± sd	Range	n	Male (N=58) Mean ± sd	Range	n
Milk	6.32±3.39	1.25-19.00	59	6.77±4.31	0.20-20.50	55
Water	3.85±4.37	0.25-27.75	57	6.67±5.77	0.50-26.25	55
Carb. bev.*	3.40±2.98	0.25-13.75	40	3.20±1.95	0.75- 9.00	37
Other*	3.39±2.96	0.50-16.00	35	4.32±2.77	1.00-10.50	31
Reconst. j. (h)*	2.42±1.89	0.25- 0.80	26	3.38±2.23	0.50- 7.75	28
Reconst. j. (c)*	2.84±2.79	1.00-12.75	20	2.17±1.42	0.25- 5.00	12
Whole juice	2.19±1.77	0.50- 5.75	12	2.79±1.64	0.50- 5.00	7
Tea	1.75±1.16	0.50- 4.00	7	2.67±1.53	1.00- 4.00	3
Soup	1.65±1.12	0.50- 5.00	17	1.44±0.89	0.25- 3.75	18
Misc.*	1.93±1.65	0.25- 4.00	7	1.17±0.29	1.00- 1.50	3
Coffee	2.00		1	0.63±0.53	0.25- 1.00	2
Three day total	17.22±5.93	4.75-45.00	61	20.22±6.67	9.25-38.00	58

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-2-A

Wetaskiwin winter beverage intake for females and males on Thursday

Beverage Category	Mean consumption in units** Female (N=45) Mean ± sd	Range	n	Male (N=49) Mean ± sd	Range	n
Milk	2.06±1.17	0.10- 5.00	41	2.64±2.02	0.50-11.00	40
Water	1.78±1.59	0.25- 7.00	40	2.08±1.76	0.25- 9.00	40
Carb. bev.*	1.33±0.63	0.25- 3.00	15	2.13±0.76	1.00- 3.50	18
Other*	1.94±1.05	1.00- 4.50	12	2.37±1.73	1.00- 6.50	13
Reconst. j. (h)*	1.75±0.87	0.75- 3.00	6	1.58±0.99	0.50- 3.50	9
Reconst. j. (c)*	1.38±0.85	0.50- 3.75	14	1.64±0.70	0.50- 2.75	11
Whole juice	1.08±0.26	0.75- 1.50	6	1.11±0.69	0.25- 2.50	9
Tea	1.75±0.50	1.00- 2.25	5	1.00		2
Soup	0.85±0.14	0.75- 1.00	5	0.92±0.54	0.50- 2.00	6
Misc.*	1.25		1			
Coffee	1.50		1	1.00		1
Daily total	5.57±2.13	2.00-12.50	45	6.29±2.10	1.25-12.75	49

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-2-B

Wetaskiwin winter beverage intake for females and males on Friday

Beverage Category	Mean consumption in units** Female (N=45) Mean ± sd	Range	n	Male (N=49) Mean ± sd	Range	n
Milk	2.18±1.06	0.50- 4.25	39	2.90±2.06	0.75-10.00	38
Water	1.69±1.33	0.25- 5.00	32	2.00±1.70	0.25- 6.25	32
Carb. bev.*	1.66±0.64	0.50- 3.50	25	2.11±1.70	0.75- 9.00	23
Other*	1.44±0.82	0.50- 3.00	9	1.63±0.67	1.00- 2.50	12
Reconst. j. (h)*	1.50±0.58	1.00- 2.00	4	1.23±0.69	0.50- 3.00	10
Reconst. j. (c)*	2.13±1.45	1.00- 5.50	15	1.64±0.84	0.75- 3.75	13
Whole juice	1.75±1.77	0.50- 3.00	2	1.38±0.75	1.00- 2.50	4
Tea	1.25±0.43	0.75- 2.00	7	1.63±0.53	1.25- 2.00	2
Soup	1.65±0.89	0.75- 3.00	5	1.00±0.43	0.75- 1.50	3
Misc.*	1.13±0.18	1.00- 1.25	2			
Coffee	1.00		1	1.13±0.18	1.00- 1.25	2
Daily total	5.67±1.96	1.00-10.50	45	5.91±2.78	2.00-19.00	49

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-2-C

Wetaskiwin winter beverage intake for females and males on Saturday

Beverage Category	Mean consumption in units** Female (N=45) Mean ± sd	Range	n	Male (N=49) Mean ± sd	Range	n
Milk	2.40±1.75	0.10- 8.00	34	2.84±2.03	0.25-10.00	40
Water	1.54±1.36	0.25- 6.50	23	1.80±1.26	0.25- 5.50	26
Carb. bev.*	1.95±1.19	0.75- 6.25	24	2.49±1.41	1.00- 7.00	34
Other*	1.92±0.95	1.00- 4.25	15	1.67±0.75	1.00- 3.00	12
Reconst. j. (h)*	1.68±1.01	1.00- 3.25	7	1.33±0.83	0.50- 3.00	9
Reconst. j. (c)*	1.75±0.78	1.00- 3.00	10	1.28±0.54	0.50- 2.25	9
Whole juice	4.00±5.84	0.25-15.50	6	1.63±0.53	1.25- 2.00	2
Tea	2.50±2.16	0.50- 5.50	4	1.25		1
Soup	1.25±0.43	0.75- 1.50	3	0.81±0.24	0.50- 1.00	4
Misc.*	1.63±0.48	1.00- 2.00	4			
Coffee	1.33±0.58	1.00- 2.00	3	1.33±0.63	0.75- 2.00	3
Daily total	6.14±2.61	3.00-15.50	45	6.19±2.70	1.50-14.00	49

** 1 unit = 200 ml

* abbreviations:

Carb. bev. = carbonated beverages
Other = other tap water added to prepare ades or punches
Reconst. j. (h) = reconstituted juice, home prepared
Reconst. j. (c) = reconstituted juice, commercially prepared
Misc. = miscellaneous

Table I-2-D

Total Wetaskiwin winter beverage intake for females and males for three days

Beverage Category	Mean consumption in units** Female (N=45) Mean ± sd	Range	n	Male (N=49) Mean ± sd	Range	n
Milk	5.70±3.33	0.20-13.50	44	7.16±5.22	1.00-24.00	46
Water	3.73±3.38	0.25-15.50	43	4.69±4.02	0.50-18.50	42
Carb. bev.*	3.09±1.53	1.00- 6.25	35	3.90±3.21	1.00-17.50	44
Other*	2.87±1.66	1.00- 6.50	23	3.51±2.96	1.00-12.00	20
Reconst. j. (h)*	2.17±1.26	0.75- 5.00	13	2.14±1.74	0.50- 8.00	18
Reconst. j. (c)*	2.87±2.42	0.50- 9.25	24	2.46±1.54	0.75- 5.00	21
Whole juice	3.78±5.61	1.00-18.50	9	2.08±1.79	0.25- 5.75	9
Tea	3.44±2.50	1.00- 7.00	8	1.63±0.75	1.00- 2.50	4
Soup	1.57±1.01	0.75- 3.75	11	1.18±0.97	0.50- 3.00	10
Misc.*	1.67±0.86	1.00- 3.25	6			
Coffee	1.63±1.25	1.00- 3.50	4	1.81±0.75	0.75- 2.50	4
Three day total	17.26±5.19	9.00-31.50	45	18.40±5.87	8.00-41.50	49

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table 1-3-A

Camrose summer beverage intake for females and males on Thursday

Beverage Category	Mean consumption in units** Female (N=58) Mean ± sd	Range	n	Male (N=53) Mean ± sd	Range	n
Milk	2.19±1.23	0.25- 5.00	53	2.63±1.42	0.50- 6.50	48
Water	1.56±1.28	0.25- 6.00	39	2.46±2.06	0.25- 7.75	41
Carb. bev.*	1.67±0.87	0.75- 3.75	16	1.51±0.64	0.50- 3.00	18
Other*	1.80±1.03	0.25- 5.00	27	1.67±0.84	0.75- 4.00	19
Reconst. j. (h)*	1.46±0.81	0.75- 3.25	11	2.05±1.42	0.50- 4.25	14
Reconst. j. (c)*	1.42±0.38	1.00- 2.00	6	1.25±0.42	0.75- 2.00	6
Whole juice	1.63±0.95	1.00- 3.00	4	1.33±0.58	1.00- 2.00	3
Tea	1.53±0.91	0.25- 3.00	8	2.30±0.84	1.00 - 3.00	5
Soup	1.31±0.69	1.00- 3.00	8	1.10±0.14	1.00- 1.25	5
Misc.*	0.50±0.35	0.25- 0.75	2	1.50±1.06	0.50- 3.00	4
Coffee	4.50		1	0.63±0.18	0.50- 0.75	2
Daily total	5.37±1.79	1.50-11.50	58	6.61±2.61	2.00-13.50	53

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-3-B

Camrose summer beverage intake for females and males on Friday

Beverage Category	Mean consumption in units** Female (N=58) Mean ± sd	Range	n	Male (N=53) Mean ± sd	Range	n
Milk	2.07±1.20	0.25- 6.00	49	2.88±1.74	0.50- 6.75	47
Water	1.42±0.99	0.25- 3.75	35	2.29±2.37	0.25-13.00	39
Carb. bev.*	2.20±1.30	0.50- 5.50	32	2.37±1.15	0.50- 5.00	24
Other*	2.07±1.34	0.50- 6.00	19	2.09±1.10	0.25- 4.00	14
Reconst. j. (h)*	1.68±1.19	0.50- 4.25	11	2.27±1.84	0.50- 6.00	13
Reconst. j. (c)*	1.25±0.57	0.50- 2.25	6	2.00±0.50	1.50- 2.50	3
Whole juice	1.16±0.61	0.50- 2.00	8	1.08±0.58	0.75- 1.75	3
Tea	1.70±0.76	1.00- 3.00	5	1.08±0.79	0.25 - 2.00	6
Soup	1.17±0.29	1.00- 1.50	3	1.06±0.13	1.00- 1.25	4
Misc.*	1.00±0.20	0.75- 1.25	4	2.50±1.80	0.50- 4.00	3
Coffee	2.25±1.06	1.50- 3.00	2			
Daily total	5.44±2.66	2.00-12.00	58	6.94±3.40	2.00-21.50	53

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-3-C

Camrose summer beverage intake for females and males on Saturday

Beverage Category	Mean consumption in units** Female (N=58) Mean ± sd	Range	n	Male (N=53) Mean ± sd	Range	n
Milk	2.02±1.34	0.25- 6.00	40	2.52±1.22	1.00- 5.50	44
Water	1.67±1.27	0.50- 5.00	23	2.52±1.72	0.50- 7.25	33
Carb. bev.*	2.08±1.23	0.75- 6.00	36	2.16±1.35	0.50- 8.00	38
Other*	1.88±1.39	1.00- 6.00	20	2.69±1.32	0.25- 5.25	17
Reconst. j. (h)*	1.34±1.04	0.50- 3.50	8	1.36±0.88	0.50- 3.00	11
Reconst. j. (c)*	1.43±0.66	0.50- 2.25	7	1.44±0.55	1.00- 2.25	4
Whole juice	1.38±1.11	0.50- 3.00	4	1.25±0.50	1.00- 2.00	4
Tea	1.88±0.89	1.00- 3.00	6	2.00±1.06	1.25 - 3.50	4
Soup	1.00		6	0.92±0.38	0.50- 1.25	3
Misc.*	1.42±1.05	0.25- 3.00	9	2.55±0.80	1.50- 3.50	5
Coffee	1.00±0.66	0.25- 1.50	3	2.00		1
Daily total	5.02±2.37	1.00-13.00	58	7.04±3.05	1.75-18.25	53

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-3-D

Total Camrose summer beverage intake for females and males for three days

Beverage Category	Mean consumption in units** Female (N=58) Mean ± sd	Range	n	Male (N=53) Mean ± sd	Range	n
Milk	5.22±3.01	0.50-11.00	57	7.60±3.67	2.00-16.50	49
Water	3.05±2.70	0.25-10.00	49	5.47±5.15	0.75-19.50	50
Carb. bev.*	3.58±2.50	0.50- 9.00	48	3.77±2.61	0.50-13.00	44
Other*	3.30±2.52	0.25-14.00	38	3.81±2.76	0.25-12.00	28
Reconst. j. (h)*	2.51±2.20	0.50- 9.75	18	3.86±2.96	0.75-10.00	19
Reconst. j. (c)*	2.17±1.48	0.50- 4.75	12	2.75±1.66	1.00- 5.50	7
Whole juice	2.13±1.39	0.50- 4.50	10	1.53±0.53	0.75- 2.00	8
Tea	3.20±1.81	1.25- 6.00	10	2.60±2.09	0.25- 6.50	10
Soup	1.33±0.58	1.00- 3.00	15	1.25±0.58	0.50- 2.50	10
Misc.*	1.37±1.01	0.25- 3.75	13	2.92±2.72	0.50- 9.50	9
Coffee	3.00±4.04	0.25- 9.00	4	1.63±1.59	0.50- 2.75	2
Three day total	15.83±5.12	7.75-35.50	58	20.59±7.40	10.00-50.75	53

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-4-A

Wetaskiwin summer beverage intake for females and males on Thursday

Beverage Category	Mean consumption in units** Female (N=39) Mean ± sd	Range	n	Male (N=46) Mean ± sd	Range	n
Milk	2.10±1.17	0.10- 5.00	35	2.68±1.46	0.50- 6.00	44
Water	1.72±1.27	0.25- 4.75	29	2.11±1.36	0.50- 6.00	35
Carb. bev.*	1.75±0.78	0.75- 3.00	15	2.02±1.16	1.00- 4.50	11
Other*	1.83±1.63	0.50- 6.00	15	1.79±0.97	0.75- 4.00	12
Reconst. j. (h)*	1.28±0.63	0.50- 2.25	8	1.34±0.60	0.75- 2.00	8
Reconst. j. (c)*	1.38±0.31	1.25- 2.00	6	1.25±0.40	0.75- 1.75	5
Whole juice	1.00		1	1.44±0.72	1.00- 2.50	4
Tea	1.35±0.65	0.50- 2.00	5	2.06±0.72	1.25- 3.00	4
Soup	1.13±0.18	1.00- 1.25	2	1.28±0.55	0.50- 2.25	9
Misc.*	1.38±0.53	1.00- 1.75	2			
Coffee	1.00		1	1.50		1
Daily total	5.37±2.02	2.00-10.25	39	6.08±2.45	2.00-12.00	46

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-4-B

Wetaskiwin summer beverage intake for females and males on Friday

Beverage Category	Mean consumption in units** Female (N=39) Mean ± sd	Range	n	Male (N=46) Mean ± sd	Range	n
Milk	1.67±0.96	0.50- 4.50	37	2.57±1.55	0.50- 7.25	42
Water	1.67±1.46	0.25- 6.00	28	1.96±1.11	0.25- 5.50	28
Carb. bev.*	1.53±0.77	0.50- 3.75	22	2.20±1.57	0.50- 7.50	27
Other*	2.32±2.15	0.75- 9.00	14	2.38±0.95	1.00- 4.00	8
Reconst. j. (h)*	1.90±1.03	1.00- 3.00	5	1.10±0.55	0.25- 2.00	12
Reconst. j. (c)*	1.50±0.72	1.00- 3.25	9	1.83±1.01	1.25- 3.00	3
Whole juice	1.13±0.53	0.75- 1.50	2	1.69±0.94	1.00- 3.00	4
Tea	0.83±0.29	0.50- 1.00	3	1.00		1
Soup	1.42±0.52	1.00- 2.00	3	1.18±0.14	1.00- 1.25	3
Misc.*	1.06±0.72	0.25- 2.00	4	0.88±0.88	0.25- 1.50	8
Coffee						
Daily total	5.41±2.41	2.00-14.50	39	5.94±2.34	0.50-13.00	46

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-4-C

Wetaskiwin summer beverage intake for females and males on Saturday

Beverage Category	Mean consumption in units** Female (N=39) Mean ± sd	Range	n	Male (N=46) Mean ± sd	Range	n
Milk	2.00±1.82	0.10- 9.00	32	2.97±1.98	1.00-11.00	39
Water	1.88±1.29	0.25- 5.00	24	2.28±1.65	0.25- 6.50	27
Carb. bev.*	2.45±1.25	0.50- 5.00	25	2.66±2.19	0.25- 9.00	24
Other*	2.42±2.54	0.50- 9.50	12	2.06±1.33	1.00- 5.00	12
Reconst. j. (h)*	1.47±0.78	0.50- 3.00	8	1.19±0.73	0.50- 3.00	9
Reconst. j. (c)*	1.50±0.92	0.25- 3.00	6	1.50±0.71	1.00- 2.00	2
Whole juice	1.08±0.14	1.00- 1.25	3	1.25±0.50	1.00- 2.00	4
Tea	1.53±0.70	0.75- 2.50	8	1.50		2
Soup						
Misc.*	0.25		1	1.33±0.29	1.00- 1.50	3
Coffee	1.33±0.58	1.00- 2.00	3	1.50		1
Daily total	6.15±3.24	1.00-16.50	39	6.37±2.76	2.25-15.75	46

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-4-D

Total Wetaskiwin summer beverage intake for females and males for three days

Beverage Category	Mean consumption in units** Female (N=39) Mean ± sd	Range	n	Male (N=46) Mean ± sd	Range	n
Milk	5.11±3.04	0.50-12.50	39	7.43±4.43	1.00-21.25	46
Water	4.30±3.13	0.50-12.00	33	4.76±2.80	0.25-10.50	40
Carb. bev.*	3.57±2.18	1.00- 9.00	34	4.41±3.55	0.50-13.00	33
Other*	3.42±4.78	0.75-24.50	26	3.63±2.38	0.75- 8.50	18
Reconst. j. (h)*	2.25±1.96	0.50- 7.00	14	2.32±1.72	0.25- 5.00	15
Reconst. j. (c)*	2.56±1.45	1.25- 6.25	12	2.11±1.39	0.75- 5.00	7
Whole juice	1.63±0.48	1.00- 2.00	4	2.50±1.89	1.00- 6.00	7
Tea	2.15±1.23	0.75- 4.00	10	2.04±1.01	1.00- 3.50	6
Soup	1.30±0.41	1.00- 2.00	5	1.36±0.77	0.50- 2.50	11
Misc.*	1.04±0.67	0.25- 2.00	7	1.15±0.55	0.25- 1.50	5
Coffee	1.67±0.58	1.00- 2.00	3	3.00		1
Three day total	16.93±6.63	7.35-39.75	39	18.39±5.88	9.75-31.75	46

** 1 unit = 200 ml

* abbreviations:
- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-5-A

Winter beverage intake for all females and all males on Thursday

Beverage Category	Mean consumption in units** Female (N=106) Mean ± sd	Range	n	Male (N=107) Mean ± sd	Range	n
Milk	2.14±1.21	0.10- 6.00	96	2.59±1.83	0.50-11.00	90
Water	1.69±1.50	0.25- 7.00	87	2.64±2.22	0.25-10.75	88
Carb. bev.*	1.31±0.69	0.25- 3.50	30	1.74±0.82	0.25- 3.50	34
Other*	1.84±1.18	0.50- 5.25	33	2.03±1.27	0.50- 6.50	36
Reconst. j. (h)*	1.64±1.81	0.50- 3.00	22	2.13±1.54	0.50- 5.50	25
Reconst. j. (c)*	1.75±1.96	0.50-10.75	27	1.55±0.61	0.50- 2.75	15
Whole juice	1.19±0.47	0.50- 2.25	12	0.98±0.60	0.25- 2.50	15
Tea	1.72±0.49	1.00- 2.25	9	1.00		3
Soup	1.02±0.33	0.75- 2.00	13	0.97±0.50	0.25- 2.25	18
Misc.*	0.75±0.50	0.25- 1.25	3	1.00		1
Coffee	1.25±0.35	1.00- 1.50	2	1.00		1
Daily total	5.51±2.10	2.00-14.00	106	6.65±2.48	1.25-13.75	107

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-5-B

Winter beverage intake for all females and all males on Friday

Beverage Category	Mean consumption in units** Female (N=106) Mean ± sd	Range	n	Male (N=107) Mean ± sd	Range	n
Milk	2.19±1.19	0.25- 7.00	94	2.77±1.83	0.20-10.00	87
Water	1.72±1.75	0.25-12.00	77	2.40±1.92	0.25- 7.50	77
Carb. bev.*	1.93±1.22	0.50- 7.00	51	2.07±1.42	0.50- 9.00	46
Other*	1.62±0.96	0.50- 4.00	27	2.02±1.03	0.75- 4.50	28
Reconst. j. (h)*	1.26±0.78	0.25- 3.00	19	1.59±0.94	0.50- 4.25	29
Reconst. j. (c)*	1.88±1.13	1.00- 5.50	29	1.59±0.80	0.75- 3.75	22
Whole juice	1.63±1.22	0.25- 4.00	10	1.25±0.53	0.75- 2.50	9
Tea	1.25±0.43	0.75- 2.00	7	1.42±0.52	1.00- 2.00	3
Soup	1.32±0.70	0.50- 3.00	11	1.19±0.75	0.75- 3.00	9
Misc.*	1.42±0.52	1.00- 2.00	3			
Coffee	1.00		2	1.08±0.14	1.00- 1.25	3
Daily total	5.66±2.32	1.00-16.25	106	6.44±2.96	1.00-19.00	107

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-5-C

Winter beverage intake for all females and all males on Saturday

Beverage Category	Mean consumption in units** Female (N=106) Mean ± sd	Range	n	Male (N=107) Mean ± sd	Range	n
Milk	2.47±1.75	0.10- 9.00	86	2.66±1.91	0.25-10.00	85
Water	1.86±1.66	0.25- 9.00	54	2.12±1.91	0.25-11.75	68
Carb. bev.*	2.05±1.40	0.25- 6.25	53	2.26±1.29	0.75- 7.00	60
Other*	2.03±1.85	0.25-11.00	39	2.11±1.35	0.50- 5.00	35
Reconst. j. (h)*	1.49±1.19	0.25- 4.25	21	1.41±0.93	0.50- 3.75	24
Reconst. j. (c)*	1.83±0.91	1.00- 3.75	13	1.31±0.58	0.25- 2.50	16
Whole juice	2.60±4.06	0.25-15.50	13	2.45±1.07	1.25- 4.00	5
Tea	1.94±1.61	0.50- 5.50	8	1.81±0.90	1.00- 3.00	4
Soup	1.50±0.81	0.75- 3.00	11	1.23±1.10	0.50- 4.00	11
Misc.*	1.89±1.05	0.50- 3.50	9	1.25±0.35	1.00- 1.50	2
Coffee	1.33±0.58	1.00- 2.00	3	1.06±0.75	0.25- 2.00	4
Daily total	6.12±2.90	0.50-19.00	106	6.30±2.79	1.50-14.00	107

** 1 unit = 200 ml

* abbreviations:

Carb. bev. = carbonated beverages
Other = other tap water added to prepare ades or punches
Reconst. j. (h) = reconstituted juice, home prepared
Reconst. j. (c) = reconstituted juice, commercially prepared
Misc. = miscellaneous

Table I-5-D

Total winter beverage intake for all females and all males for three days

Beverage Category	Mean consumption in units** Female (N=106) Mean ± sd	Range	n	Male (N=107) Mean ± sd	Range	n
Milk	6.05±3.36	0.20-19.00	103	6.95±4.73	0.20-24.00	101
Water	3.80±3.96	0.25-27.75	100	5.81±5.16	0.50-26.25	97
Carb. bev.*	3.26±2.40	0.25-13.75	75	3.58±2.71	0.75-17.50	81
Other*	3.17±2.52	0.50-16.00	58	4.01±2.85	1.00-12.00	51
Reconst. j. (h)*	2.34±1.70	0.25- 8.00	39	2.90±2.12	0.50- 8.00	46
Reconst. j. (c)*	2.85±2.56	0.50-12.75	44	2.36±1.48	0.25- 5.00	33
Whole juice	2.87±3.87	0.50-18.50	21	2.39±1.71	0.25- 5.75	16
Tea	2.65±2.12	0.50- 7.00	15	2.07±1.17	1.00- 4.00	7
Soup	1.62±1.06	0.50- 5.00	28	1.35±0.91	0.25- 3.75	28
Misc.*	1.81±1.30	0.25- 4.00	13	1.17±0.29	1.00- 1.50	3
Coffee	1.70±1.10	1.00- 3.50	5	1.42±0.88	0.25- 2.50	6
Three day total	17.24±5.61	4.75-45.00	106	19.39±6.35	8.00-41.50	107

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-6-A

Summer beverage intake for all females and all males on Thursday

Beverage Category	Mean consumption in units** Female (N=97) Mean ± sd	Range	n	Male (N=99) Mean ± sd	Range	n
Milk	2.15±1.20	0.10- 5.00	88	2.65±1.43	0.50- 6.50	92
Water	1.63±1.27	0.25- 6.00	68	2.29±1.77	0.25- 7.75	76
Carb. bev.*	1.71±0.82	0.75- 3.75	31	1.71±0.90	0.50- 4.50	29
Other*	1.81±1.26	0.25- 6.00	42	1.72±0.88	0.75- 4.00	31
Reconst. j. (h)*	1.38±0.72	0.50- 3.25	19	1.80±1.22	0.50- 4.25	22
Reconst. j. (c)*	1.40±0.33	1.00- 2.00	12	1.25±0.39	0.75- 2.00	11
Whole juice	1.50±0.87	1.00- 3.00	5	1.39±0.61	1.00- 2.50	7
Tea	1.46±0.80	0.25- 3.00	13	2.19±0.75	1.00- 3.00	9
Soup	1.28±0.62	1.00- 3.00	10	1.21±0.45	0.50- 2.25	14
Misc.*	0.94±0.63	0.25- 1.75	4	1.50±1.06	0.50- 3.00	4
Coffee	2.75±2.48	1.00- 4.50	2	0.91±0.52	0.50- 1.50	3
Daily total	5.37±1.88	1.50-11.50	97	6.37±2.54	2.00-13.50	99

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-6-B

Summer beverage intake for all females and all males on Friday

Beverage Category	Mean consumption in units** Female (N=97) Mean ± sd	Range	n	Male (N=99) Mean ± sd	Range	n
Milk	1.89±1.12	0.25- 6.00	86	2.73±1.65	0.50- 7.25	89
Water	1.53±1.22	0.25- 6.00	63	2.15±1.94	0.25-13.00	67
Carb. bev.*	1.93±1.15	0.50- 5.50	54	2.28±1.38	0.50- 7.50	51
Other*	2.17±1.71	0.50- 9.00	33	2.19±1.03	0.25- 4.00	22
Reconst. j. (h)*	1.75±1.11	0.50- 4.25	16	1.71±1.48	0.25- 6.00	25
Reconst. j. (c)*	1.40±0.65	0.50- 3.25	15	1.92±0.72	1.25- 3.00	6
Whole juice	1.15±0.57	0.50- 2.00	10	1.43±0.81	0.75- 3.00	7
Tea	1.38±0.74	0.50- 3.00	8	1.07±0.72	0.25- 2.00	7
Soup	1.29±0.40	1.00- 2.00	6	1.11±0.13	1.00- 1.25	7
Misc.*	1.03±0.49	0.25- 2.00	8	1.85±1.62	0.25- 4.00	5
Coffee	2.25±1.06	1.50- 3.00	2			
Daily total	5.43±2.31	2.00-14.50	97	6.47±2.98	0.50-21.50	99

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-6-C

Summer beverage intake for all females and all males on Saturday

Beverage Category	Mean consumption in units** Female (N=97) Mean ± sd	Range	n	Male (N=99) Mean ± sd	Range	n
Milk	2.01±1.56	0.10- 9.00	72	2.73±1.62	1.00-11.00	83
Water	1.78±1.27	0.25- 5.00	47	2.41±1.68	0.25- 7.25	60
Carb. bev.*	2.23±1.24	0.50- 6.00	61	2.35±1.73	0.25- 9.00	62
Other*	2.08±1.88	0.50- 9.50	32	2.43±1.34	0.25- 5.25	29
Reconst. j. (h)*	1.41±0.89	0.50- 3.50	16	1.28±0.80	0.50- 3.00	20
Reconst. j. (c)*	1.46±0.76	0.25- 3.00	13	1.46±0.53	1.00- 2.25	6
Whole juice	1.25±0.80	0.50- 3.00	7	1.25±0.46	1.00- 2.00	8
Tea	1.68±0.78	0.75- 3.00	14	1.83±0.86	1.25- 3.50	6
Soup	1.00		6	0.92±0.38	0.50- 1.25	3
Misc.*	1.30±1.05	0.25- 3.00	10	2.09±0.89	1.00- 3.50	8
Coffee	1.17±0.59	0.25- 2.00	6	1.75±0.35	1.50- 2.00	2
Daily total	5.48±2.79	1.00-16.50	97	6.73±2.92	1.75-18.25	99

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

Table I-6-D

Total summer beverage intake for all females and all males for three days

Beverage Category	Mean consumption in units** Female (N=97) Mean ± sd	Range	n	Male (N=99) Mean ± sd	Range	n
Milk	5.18±3.00	0.50-12.50	96	7.52±4.04	1.00-21.25	95
Water	3.55±2.93	0.25-12.00	82	5.15±4.26	0.25-19.50	90
Carb. bev.*	3.58±2.36	0.50- 9.00	82	4.05±3.04	0.50-13.00	77
Other*	3.35±3.58	0.25-24.50	64	3.74±2.60	0.25-12.00	46
Reconst. j. (h)*	2.40±2.07	0.50- 9.75	32	3.18±2.57	0.25-10.00	34
Reconst. j. (c)*	3.37±1.45	0.50- 6.25	24	2.43±1.51	0.75- 5.50	14
Whole juice	1.98±1.15	0.50- 4.50	14	1.98±1.39	0.75- 6.00	15
Tea	2.68±1.60	0.75- 6.00	20	2.39±1.74	0.25- 6.50	16
Soup	1.33±0.53	1.00- 3.00	20	1.31±0.67	0.50- 2.50	21
Misc.*			20	2.29±2.33	0.25- 9.50	14
Coffee	2.43±2.96	0.25- 9.00	7	2.08±1.38	0.50- 3.00	3
Three day total	16.27±5.77	7.35-39.75	97	19.57±6.79	9.75-50.75	99

** 1 unit = 200 ml

* abbreviations:

- Carb. bev. = carbonated beverages
- Other = other tap water added to prepare ades or punches
- Reconst. j. (h) = reconstituted juice, home prepared
- Reconst. j. (c) = reconstituted juice, commercially prepared
- Misc. = miscellaneous

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